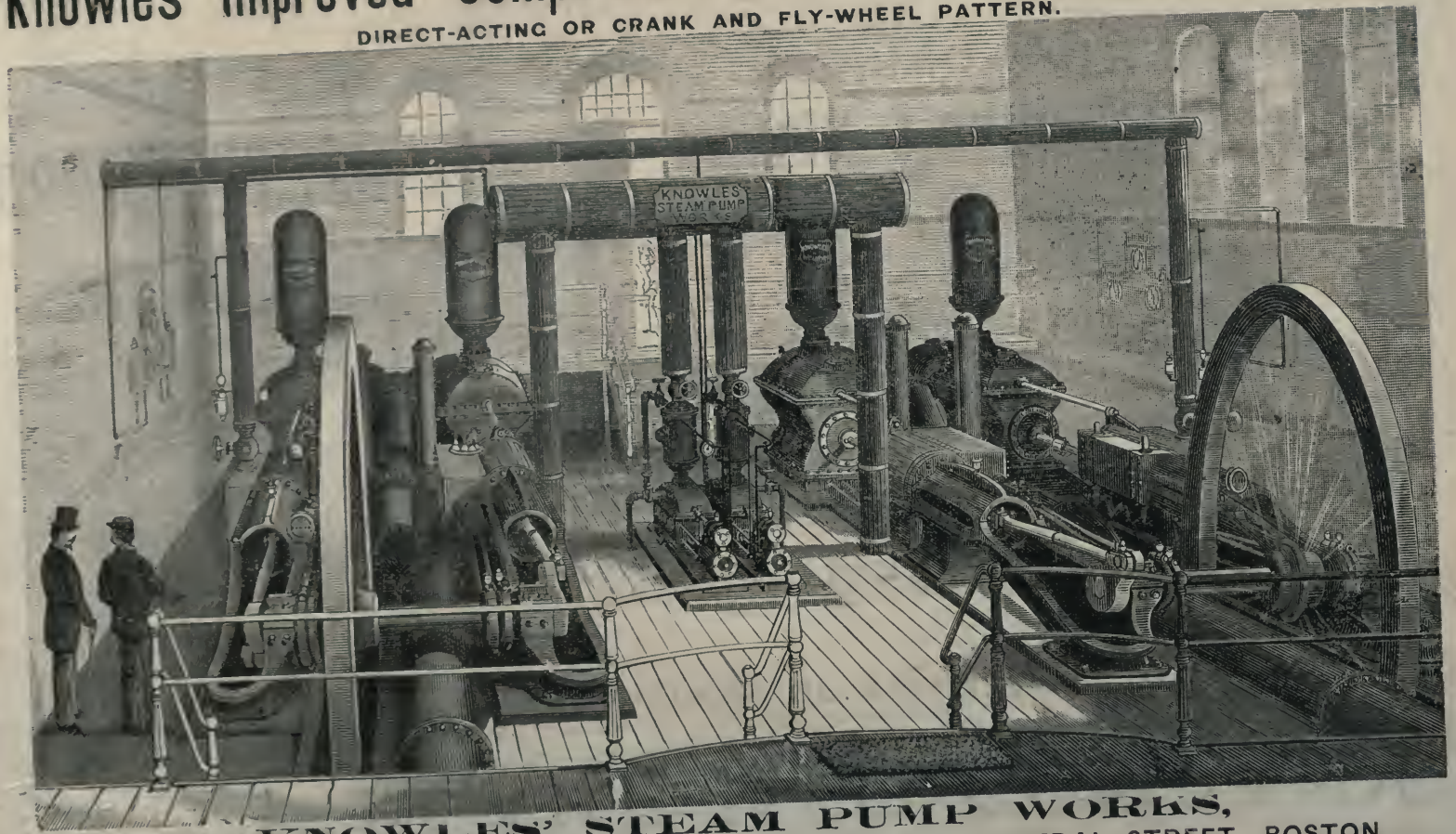
The Manual of American Water-Works

1889-90

Engineering News

Knowles' Improved Compound Condensing Pumping Engines.

DIRECT-ACTING OR CRANK AND FLY-WHEEL PATTERN.



KNOWLES' STEAM PUMP WORKS,

111 FEDERAL STREET, BOSTON.

93 LIBERTY STREET NEW YORK

GEO. F. BLAKE MFG. COMPANY

BUILDERS OF STEAM AND POWER

Physical & Applied Sci. Serials

FOR WATER-WORKS SERVICE.

THE BLAKE IMPROVED

Compound Condensing Duplex Pumping Engines,

GEO. F. BLAKE MANUFACTURING COMPANY,

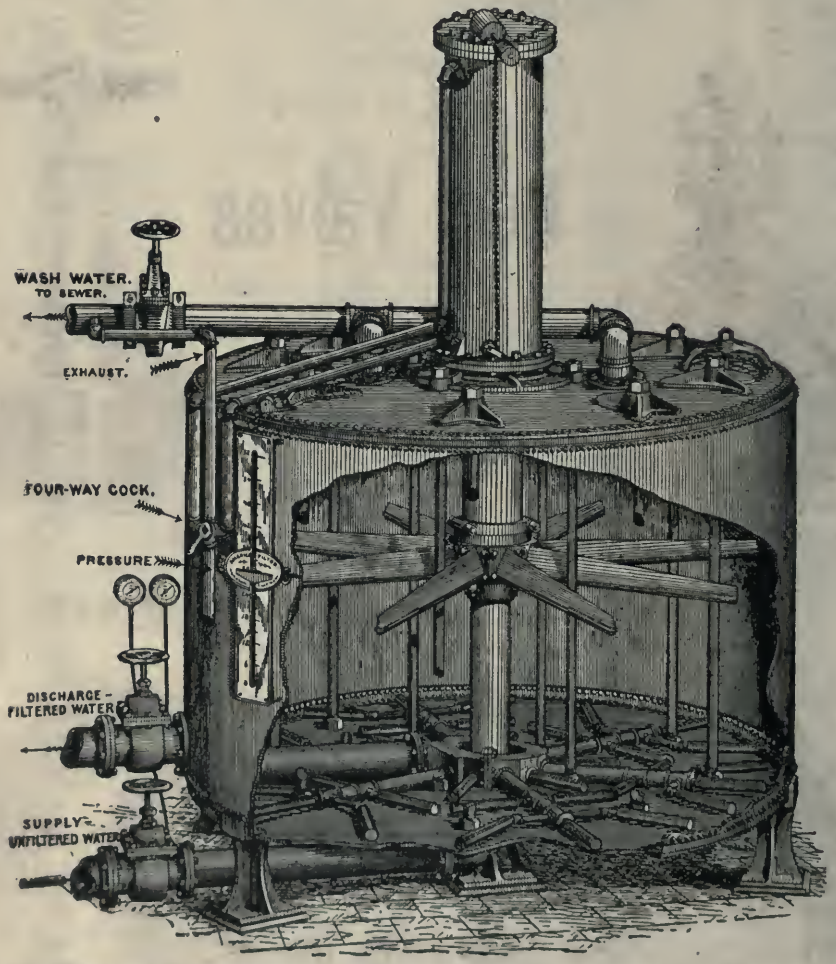
95 and 97 Liberty Street, New York.

535 Arch Street, Philadelphia.

111 Federal Street, Boston.

THE AMERICAN FILTER.

SIMPLE—POSITIVE—RELIABLE.



Pure Water Supplies for Cities, Towns, Factories, Breweries, Cotton and Woollen Mills, Railroads, etc.

Has been adopted by TEN LARGE CITIES during the past year, and is extensively used for purifying boiler feed water by the leading manufactories of the United States

All Sizes and Capacities. Plans and Estimates Furnished.

CORRESPONDENCE SOLICITED.

AMERICAN FILTER COMPANY,

551, 553, 555 "The Rookery," Chicago, Ill.

Physical & Applied Sci. Serials

PEET VALVE CO.

MANUFACTURERS OF THE

GENUINE

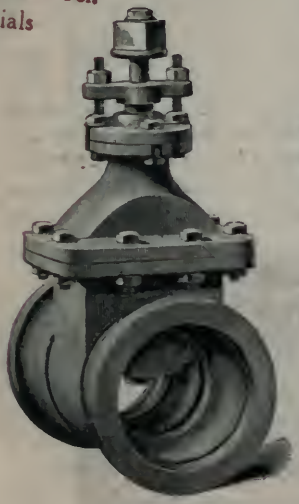
DOUBLE GATE

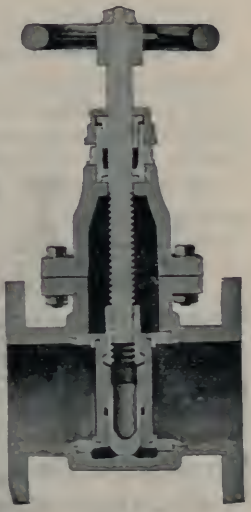
Peet Valves

—FOR—

Steam, Water, Gas, etc.

1-4 to 36 in.





163 Albany St., Boston, Mass.

AGENCIES:

Chicago.....John Davis & Co.	Chattanooga..... C. E. James & Co.
St. Louis.....N. O. Nelson Mfg. Co.	New Orleans .....M. Schwartz.
Denver.... ... .Davis-Creswell Mfg. Co.	Baltimore.....Crook, Horner & Co.
Omaha.....A. L. Strang & Sons.	Philadelphia .....John Maneely.
Minneapolis.....Russell, Boynton & Co.	Kansas City.....English, Morse & Co.
Cleveland .....The W. Bingham Co.	Detroit..... .....A. Harvey & Son.
Buffalo .....W. A. Case & Son.	Milwaukee .....Rundle, Spence & Co.
New York..... ..Colwell Lead Co.	San Francisco.....W. T. Garrott & Co.

Physical & Applied Sci. Serials

INDEX TO ADVERTISEMENTS AND BUSINESS DIRECTORY.

The names and addresses of ADVERTISERS in the MANUAL are shown in prominent type; the names and addresses of SUBSCRIBERS who have paid in advance, *and who desire it*, are given in smaller type and under appropriate headings, one heading for each book paid for. This Directory will soon be a most complete list of Manufacturers and Dealers in Water-Works Machinery and Supplies; also of Engineers, Contractors, Brokers, and others interested in the subject of Water-Works Construction, and its value cannot fail to be appreciated. There is *only one* MANUAL OF AMERICAN WATER-WORKS, and the easiest way to be known in the Water-Works interest is to be represented in its pages either as an ADVERTISER or a SUBSCRIBER.

AERATING WATER.

Rand Drill Co., 23 Park Place, N. Y..... 729

AIR COMPRESSORS.

Rand Drill Co., N. Y. City..... 729

ARCHITECT.

Ellsworth, Emory A., Holyoke, Mass... 750

ARCHITECTS' AND ENGINEERS' SUPPLIES.

Frost & Adams, 37 Cornhilll. Mass..... 739
Kueffel & Esser Co., New York..... xv

ARCHITECTURAL IRON WORK.

E. L. Dent's Iron Works, Georgetown, D. C..... xxi

ARCHITECTURAL PHOTO-GRAPHERS.

Frost & Adams, 37 Cornhill, Boston, Mass 739
Kueffel & Esser Co., New York.... xv

ARTESIAN WELLS.

F. C. Austin Mfg. Co., Chicago, Ill..... 733
Oil Well Supply Co., Limited, 82 Fulton St., N. Y..... 757
Pierce Artesian Well & Supply Co., 80 Beaver St., N. Y..... . 759

BAND (for Tapping Cement Lined Pipe).

Holton & Co., Fred H., 52 Pearl St., Boston, Mass..... 739

BANKERS.

Coffin & Stanton, 72 Broadway, N. Y., and 47 Old Broad St., London, Eng 749
GILLIGAN, H. M., 64 Broadway, N. Y.
Kean & Co., S. A., Chicago and New York..... xiii

BANKERS.—Continued.

Loring, S. D., 89 State St., Boston, Mass... xxi
Venner & Co., C. H., Boston and New York. Outside back cover.

BELTING AND HOSE (Rubber).

Boston Belting Co., 256 Devonshire, St., Boston, Mass., and and 100 Chambers St., N. Y..... 745

BLUE PROCESS PAPERS.

Frost & Adams, 37 Cornhill, Boston, Mass. 739
Keuffel & Esser Co., New York. Page xv.

BOILER COMPOUNDS.

LITOFUGE MANUFACTURING CO., 62 John St., N. Y.
PITTSBURGH BOILER SCALE RESOLVENT CO., Verner Buildings, Pittsburg, Pa.

BOILERS (Steam).

R. F. Hawkins Iron Works, Springfield, Mass..... 745
Oil Well Supply Co., 82 Fulton St., N. Y. 757
Pancoast & Rogers, 28 Platt St., N. Y. ix
Pierce & Thomas, 42 Cortland St., N. Y. xiii
Porter Mfg. Co., Ltd., Syracuse, N. Y.. 758
Sharon Boiler Works, Sharon, Pa..... 751
Taunton Locomotive Mfg. Co., Taunton, Mass..... 763
Tippett & Wood, Phillipsburg, N. J..... 760

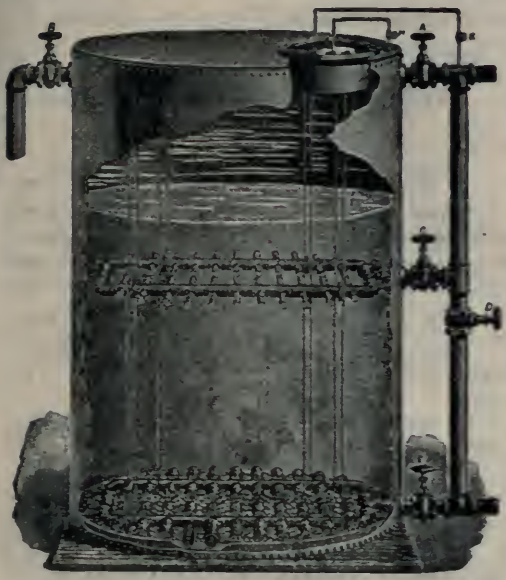
BOILER TUBES.

National Tube Works, Co., McKeesport, Pa..... 725
Pancoast & Rogers, 28 Platt St..... ix

BOLTS.

R. F. Hawkins Iron Works, Springfield, Mass 745

NATIONAL FILTER.



21 CITIES

Have Adopted our Process.

Largest Mechanical Filtering Plants in the World:

CHATTANOOGA, TENN.—Six million gallons per day.
(Plant when first installed was three million gallons.)

TERRE HAUTE, IND.—Three million gallons per day.
(Ten-foot diam. filter cases, 200 lbs. test pressure per square inch, without braces.)

Are now building Filter Plants, consisting of 20-foot diameter filters, one million gallons capacity each.

Send for Illustrated Catalogues to

NATIONAL WATER PURIFYING COMPANY,

145 Broadway and 86 Liberty St., New York.

Refer, by permission, to HENRY R. WORTHINGTON.

THE

MORISON-ALLEN CO.,

MANUFACTURERS OF

IMPROVED WATER PURIFIERS,

No. 145 BROADWAY, NEW YORK.

Improved Systems of Filtration—GRAVITY AND PRESSURE.

W. F. & F. C. Sayles, Saylesville, R. I.	Capacity—	3,000,000	Galls. Daily
American Wood Paper Co., Manayunk, Pa.	"	2,000,000	"
Albermarle Paper Mfg. Co., Richmond, Va.	"	1,000,000	"
The Franklin Sugar Refinery Co., Phila., Pa	"	500,000	"
Trenton Iron Co., Trenton, N. J.	"	500,000	"
Diamond Ice Co., Wilmington, Del.	"	150,000	"
Cranston's Hotel, West Point, N. Y.	"	200,000	"

And many others.

THE MORISON-ALLEN COMPANY, 145 BROADWAY, NEW YORK.

BRIDGES AND ROOFS (Iron).

R. F. Hawkins Iron Works, Springfield, Mass..... 745
Tippett & Wood, Phillipsburg, N. J..... 760
R. D. Wood & Co., 400 Chestnut St., Philadelphia.....xxiv

CARS AND CAR WHEELS.

Jackson & Woodin Mfg. Co., Berwick, Pa..... 747

CASTINGS (Globe Special).

Builders' Iron Foundry, Providence, R. I..... 758
M. J. Drummond, Corbin Building, 192 Broadway, New York..... 737

CASTINGS (Machine and Special).

Addyston Pipe and Steel Co., Addyston, O., and Newport, Ky..... 747
Drummond, M. J., 192 Broadway, N. Y. 737
R. F. Hawkins Iron Works, Springfield, Mass..... 745
Mellert Foundry & Machine Co., Reading, Pa..... 743
Pancoast & Rogers, 28 Platt St..... ix
South Pittsburg Pipe Works, South Pittsburg, Tenn..... 741
Taunton Locomotive Works, Taunton, Mass..... 763
Wood & Co., R. D., 400 Chestnut St., Philadelphia, Pa.....xxiv

CASTINGS (Car and R. R.).

Jackson & Woodin Mfg. Co., Berwick, Pa..... 747
Mellert Foundry & Machine Co., Reading, Pa..... 743

CAULKING TOOLS.

Taunton Loco. Mfg. Co., Taunton, Mass..... 763

CEMENT (Portland).

Fisher, Erskine W., 18 Broadway, N. Y. 759
Lawrence Cement Co., 67 William St., N. Y.....xvii
New York Cement Co., 18 Cortlandt St., N. Y.....xvii
N. Y. & Rosendale Cement Co., 229 Broadway, N. Y.....xix
SINCLAIR & BABSON, 16 Exchange Place, N. Y.

COCKS (Stop and Corporation).

Hays Manufacturing Co., Erie, Pa.... 711
H. Mueller Mfg. Co., Decatur, Ill..... 715
King & Coddard, 29 Pearl St., Boston, Mass.....See colored page.
The E. Stebbins Manufacturing Co., Brightwood P. O., Mass..... 733
Holton & Co., Fred. H., 52 Pearl St., Boston, Mass..... 739

COCKS (Service and Waste).

Hays Manufacturing Co., Erie, Pa.... 711
H. Mueller Mfg. Co., Decatur, Ill..... 715

CONDENSATION (Improved System of).

Hill, John W., Cincinnati, O..... 762

CONTRACTORS (Water, Gas, Sewers, Pavements).

Jas. H. Harlow & Co., 411 Wood St., Pittsburg, Pa..... 751
A. L. Holmes, Grand Haven, Mich..... 751
Moffett, Hodgkins & Clarke, Syracuse, N. Y..... 735
Troy Public Works Co., Troy, N. Y.... 737
R. D. Wood & Co., 400 Chestnut St., Philadelphia, Pa..... xii
Woltmann, Keith & Co., 11 Wall St., N. Y..... 751

CONNECTING BRANCH SLEEVE (Tapping Pipe).

Smith, A. P., 130 Halsey St., Newark, N. J. 755

CONTRACTORS' SUPPLIES.

TOMKINS, CALVIN, 150 Broadway, N. Y.

COPPER AND BRASS GOODS.

Bourbon Copper & Brass Works, 198 to 204 E. Front St., Cincinnati, O..... 727
Calvin Brass & Iron Works, Detroit, Mich..... 761
Hays Manufacturing Co., Erie, Pa.... 711
Holton & Co., Fred. H., 52 Pearl St., Boston, Mass..... 739
King & Coddard, 29 Pearl St., Boston, Mass..... See colored page.
Mueller Mfg. Co., H., Decatur, Ill.. 715
Oil Well Supply Co., Limited, 82 Fulton St., N. Y..... 757
The E. Stebbins Manufacturing Co., Brightwood, P. O. Mass..... 733

CRANES, ELEVATORS (Hydraulic).

Wood & Co., R. D., 400 Chestnut St., Philadelphia, Pa.....xxiv
Tuerk Hydraulic Power Co., Chicago and New York..... 727

CULVERT PIPE.

Blackmer & Post, St. Louis, Mo 753

CURB BOXES.

Douglas, W. & B., Middletown, Conn.. 74
Hays Manufacturing Co., Erie, Pa... 711
King & Coddard, 29 Pearl St., Boston, Mass..... ....See colored page.
Taunton Loco. Mfg. Co., Taunton, Mass..... 763

WATER AND GAS WORKS SUPPLIES.

LEADING IRON COMPANY'S

Wrought Iron Steam, Gas and Water Pipe, Boiler Tubes, Artesian Well Pipe and Casing, and Special Work of Every Character.

MALLEABLE and GRAY IRON FITTINGS

FOR GAS, STEAM AND WATER.

CAST-IRON WATER, GAS and FLANGE PIPE, SPECIAL CASTINGS, Etc.

CHAPMAN VALVE MFG. CO.'S GATES AND HYDRANTS.

Specifications for bids solicited and estimates of cost given on Heavy Machinery, Boilers, Tanks, Stand Pipes, and all engineering work in iron.

PANCOAST & ROGERS,

Office and Warehouse: 28 PLATT and 15 GOLD STS - NEW YORK.

CYLINDERS (Hydraulic).

Addyston Pipe and Steel C-., Addyston, O., and Newport, Ky..... 747

DAMPER REGULATORS.

HINE & ROBERTSON, 45 Cortlandt St., N. Y.

DIVERS.

Thacher & Breymann, 28 Summit St., Toledo, O..... xxi

DIVING APPARATUS.

Schrader & Son, A., 32 Rose St., N. Y. xxi

DRAUGHTSMEN'S SUPPLIES.

Frost & Adams, 37 Cornhill, Boston, Mass 739
Keuffel & Esser Co., New York..... xv

DRILLS (Ratchet).

Lowell Wrench Co., Worcester, Mass,.. 757

DRINKING FOUNTAINS.

Jenks, Henry F., Pawtucket, R. I..... 759
Ripley & Bronson, St. Louis, Mo..... 749

ENGINEERS (Civil and Hydraulic).

Babcock, Stephen E., Little Falls, N.Y. 750
Bassett Bros., 298 Main St., Buffalo, N.Y. 758
Cassin, Isaac S., 1404 N. 12th St., Philadelphia, Pa..... 750
Croes, J. Jas. R., 13 William St., New York..... 750
Dodwell & Hogg, 52 Imperial Building, Montreal, Can..... 750
Ellsworth, Emory A., Holyoke, Mass.. 750
Fanning, Jno. T., St. Paul, Minn..... 750
Fitzgerald, J. Leland, Schenectady, N. Y..... 750
Fuller, Frank L., 12 Pearl St., Boston, Mass..... 758
Harman, Jacob A., Watseka, Ill..... 758
Harlow, James H., Pittsburgh, Pa..... 751
Hering, Rudolph, 277 Pearl St., New York 751
Hill, Jno. W, Glenn Building, Cincinnati, O..... 758
Hornung, Geo., 30 E. 4th St., Cincinnati, O. 751
Holmes, A. L., Grand Haven, Mich..... 751
Hydraulic Contracting Co., 120 Broadway, N. Y..... xxi
MacDougall, Alan, 32 Adelaide St., E. Toronto, Can..... 750
McClintock & Woodfall, 23 Court St., Boston, Mass..... 758
Nier, Hartford & Mitchell, Kansas City, Mo., and Chattanooga, Tenn. 751
Woltmann, Keith & Co., 11 Wall St., New York City..... 751
Rosewater & Chrysler, 422 Bee Building, Omaha, Neb..... 758
Wright & Wood, City Hall, Knoxville, Tenn..... 758

ENGINEERS (Civil and Hydraulic).—Continued.

Moffett, Hodgkins & Clarke, Syracuse, N. Y..... 735
Troy Public Works Co., Troy, N. Y... 737
Wynn, Geo. W., Cedar Rapids, Ia..... 758

ENGINEERS (Contracting).

Bassett Bros., 298 Main St., Buffalo, N. Y. 758
GAMBLE, JAMES, 68 Wall St., N. Y.
Harlow & Co., Jas. H., 411 Wood St., Pittsburg, Pa..... 751
Holmes, A. L., Grand Haven, Mich..... 751
Hydraulic Contracting Co., 120 Broadway, N. Y xxi
Moffett, Hodgkins & Clarke, Syracuse, N. Y.; New York and Chicago. 735
Pond Engineering Co., St. Louis, Mo. 765
Troy Public Works Co., Troy, N. Y... 737
Woltmann, Keith & Co., 11 Wall St., New York..... 751

ENGINEERS (Mechanical).

Carr, Charles, 7 Exchange Place, Boston, Mass..... 717
Hornung, Geo., 30 E. Fourth St., Cincinnati, O..... 751

ENGINES (Steam).

Oil Well Supply Co., 82 Fulton St., N. Y. 757
Porter Mfg. Co., Ltd., Syracuse, N. Y.. 758

EXCAVATING MACHINERY.

Carson, H. A., 68 Devonshire St., Boston, Mass 762

EXHAUST HEADS.

HINE & ROBERTSON, 45 Cortlandt St., N. Y.

EXPLOSIVES.

Rendrock Powder Co., 23 Park Place, New York..... 729

EXTENSION SERVICE BOXES.

Hays Manufacturing Co., Erie, Pa... 711
King & Goddard, 29 Pearl St., Boston, Mass..... .....See colored page.
Millar, Charles & Son, Utica, N. Y. xix

FANS (Ventilating and Fly).

Chicago Water Motor Co., 51 Dearborn St., Chicago, Ill..... 751

FILTERS.

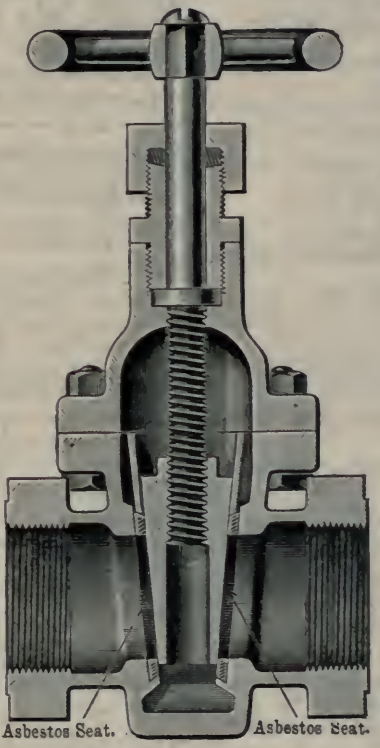
American Filter Co., Chicago, Ill. iv
Cumberland Mfg. Co., 220 Devonshire St., Boston, Mass..... 763
Hyatt Pure Water Co., New York City, N. Y..... 764
Morison-Allen Co., 145 Broadway, N. Y. vii
National Water Purifying Co., 145 Broadway, N. Y..... vii

FAIRBANKS
GATE VALVES

Renewable Seat.

FOR

Steam,
Water,
Gas,
Oil,
Ammonia,
Etc.



Brass and
Iron Body,
All Sizes,
Carried
in Stock.

Double Seated.

These valves are fitted with renewable seats of vulcabeston which can be easily removed by taking off the bonnet. Having a double seat and solid plug, the pressure can be applied at either end.

ALL VALVES GUARANTEED. SEND FOR PRICE LIST.

FAIRBANKS & CO.,

311 BROADWAY, N. Y.

216 Main St., Buffalo, N. Y.
19 Light St., Baltimore, Md.
53 Camp St., New Orleans, La.
382 Broadway, Albany, N. Y.
701 & 703 Arch St., Philadelphia, Pa.
302 Wood St., Pittsburgh, Pa.

FIRE DEPARTMENT SUPPLIES.

CHRISTIE & LE COUNT, 351 Canal St., N. Y.

Ripley & Bronson, St. Louis, Mo..... 749

FIRE ENGINES.

CHRISTIE & LE COUNT, 351 Canal St., N. Y.

FITTINGS (Brass and Iron).

JAMES, JACOB, 84 John St., N. Y.

King & Goddard, 29 Pearl St., Boston, Mass..... ..See colored page.

FITTINGS (Malleable and Cast-Iron).

Hays Manufacturing Co., Erie Pa.... 711

Pancoast & Rogers, 28 Platt St., N. Y. ix

FIRE HOSE.

EUREKA FIRE HOSE CO., 13 Barclay St., N.Y.

CHRISTIE & LE COUNT, 351 Canal St., N. Y.

FLEXIBLE JOINT.

A. L. Holmes, Grand Haven, Mich..... 751

FOUNDERS AND MACHINISTS, (General).

Builders Iron Foundry, Providence, R. I..... 758

South Pittsburg Pipe Works, South Pittsburg, Tenn..... 741

Mellert Foundry & Machine Co., Reading, Pa..... 743

Taunton Loco. Mfg. Co., Taunton, Mass..... 763

FOUNTAINS (Lawn and Drinking).

Jenks, Henry F., Pawtucket, R. I..... 759

Ripley & Bronson, St. Louis, Mo..... 749

FURNACES (Lead).

Taunton Loco. Mfg. Co., Taunton, Mass..... 763

GROUND KEY WORK.

The E. Stebbins Mfg. Co., Brightwood P. O., Springfield, Mass..... 733

HEATING (Hot Water and Steam.)

E. L. Dent's Iron Works, Georgetown, D. C..... xxi

HOIST (Differential).

Boston & Lockport Block Co., 102 Commercial St., Boston, Mass..... 741

HOISTING ENGINES.

Pierce & Thomas, 42 Courtlandt St., N. Y..... xiii

HOSE (Rubber).

Boston Belting Co., Boston and New York..... 745

King & Goddard, 29 Pearl St., Boston, Mass..... .....See colored page.

Ripley & Bronson, St. Louis, Mo..... 749

HUB SHAKING GRATE.

Portsmouth Wrench Co., 151 Congress St., Boston, Mass..... 765

HYDRANTS.

Bourbon Copper & Brass Works, 198 East Front St., Cincinnati, O..... 727

Carr, Chas., 7 Exchange Place, Boston, Mass..... 717

Chapman Valve Co., Boston and Chicago (opposite preface)..... xxvi

Dent's Iron Works, E. L., Georgetown, D. C..... xxi

Drummond, M. J., 192 Broadway, N. Y.. 737

Douglas, W. & B., Middletown, Conn.... 741

Eddy Valve Co., Waterford, N. Y..... xx

Fox, John, 160 Broadway, N. Y..... 743

Calvin Brass & Iron Works, Detroit, Mich..... 761

Gloucester Iron Works, 401 Chestnut St., Philadelphia, Pa..... 747

Hays Manufacturing Co., Erie, Pa... 711

Holyoke Hydrant and Iron Works, Holyoke, Mass.... 723

Kennedy, D., 52 Cliff St., N. Y.....

King & Goddard, 29 Pearl St., Boston, Mass..... .....See colored page.

Ludlow Valve Mfg. Co., 938 River St., and 67 Vail Ave., Troy, N. Y..... 713

Mellert Foundry & Machine Co., Reading, Pa..... 743

Millar & Son, Charles, Utica, N. Y.... xix

Pancoast & Rogers, 28 Platt St.. N. Y.. ix

Peet Valve Co., 163 Albany St., Boston, N. Y..... v

Ripley & Bronson, 800 N. Second St., St. Louis, Mo..... 749

R. D. Wood & Co., 400 Chestnut St., Philadelphia, Pa..... xxiv

HYDRANTS (Irrigating).

Lacy Mfg. Co., Los Angeles, Cal..... 743

HYDRAULIC ELEVATOR.

Tuerk Hydraulic Power Co., Chicago and New York..... 727

R. D. Wood & Co., 400 Chestnut St., Philadelphia, Pa..... xxiv

INSTRUMENTS (Astronomical, Engineering, Mathematical and Meteorological).

Frost & Adams, 37 Cornhill St., Boston, Mass..... 739

Keuffel & Esser Co., New York City.... xv

INVESTMENT SECURITIES.

BOYS & CO., JAMES, 50 Exchange Place, N. Y.

Coffin & Stanton, 72 Broadway, N. Y... 746

Kean & Co., S. A., Chicago and New York..... xiii

CHICAGO. NEW YORK.

S. A. KEAN & CO.,

BANKERS,

BUY AND SELL FIRST-CLASS

WATER BONDS.

Correspondence solicited from Contractors and others desiring to market such securities.

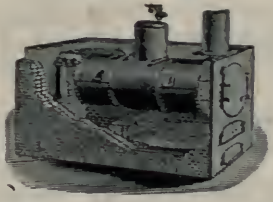
ALSO DEAL IN HIGH GRADE

MUNICIPAL BONDS

AND TRANSACT

GENERAL BANKING BUSINESS.

115 BROADWAY, NEW YORK



STAND PIPES,

TANKS,

Boilers, Hoisting Engines.

Pierce & Thomas,

42 Cortlandt St. - - New York City.

INVESTMENT SECURITIES.—Continued.

Loring, S. D., 89 State St., Boston, Mass... xxi
Venner & Co., C. H., Boston, Mass., outside back cover.

IRON (Bar).

Jackson & Woodin Mfg. Co., Berwick, Pa..... 747

LAMP POSTS.

Drummond, M. J., Corbin Building, 192 Broadway, N. Y..... 737
Mellert Foundry & Machine Co., Reading, Pa..... 743

LEAD (White and Red) AND LITHARGE.

Boston Lead Manufacturing Co., 162 Congress St., Boston, Mass.... 739

LEAD AND TIN (Pig).

Boston Lead Manufacturing Co., Boston, Mass..... 739
Ripley & Bronson, 800 N. Second St., St. Louis, Mo. 749

LOAM WORK.

South Pittsburg P pe Works, South Pittsburg, Tenn..... 741
R. D. Wood & Co., 400 Chestnut St., Philadelphia, Pa.....xxiv

METERS (Water).

Henry R. Worthington, N. Y. City, inside last cover..... 767
Hersey Meter Co., South Boston, Mass . 721
National Meter Co., 252 Broadway, N. Y.....706, 707
Union Water Meter Co., Worcester, Mass..... 719
Water Waste Prevention Co., 12 Temple Court, N. Y..... 762

MILLS AND HYDRAULIC MACHINERY.

Ellsworth, Emory A., Holyoke, Mass .. 750
Fanning, J. T., St. Paul, Minn..... 750

METER DIAL RECORDS.

Ira S. Schrop, South Bend, Ind.... 759

MOTORS (Water).

Belknap Water Motor Co., 22 Exchange St., Portland, Me..... 731
Chicago Water Motor Co., 51 Dearborn St., Chicago, Ill..... 751
Roberts & Co., Geo. J., Dayton, O.... 759
Tuerk Hydraulic Power Co., Chicago and New York..... 727

OIL EXTRACTORS.

HINE & ROBERTSON, 45 Cortlandt St., N. Y.

PACKING (Steam and Water).

Boston Belting Co., Boston, Mass., and 100 Chambers St., N. Y..... 745
Gould Packing Co., 36 Cambridge St., E. Cambridge, Mass..... 759
Charles Millar & Son., Utica, N. Y.... xix
HINE & ROBERTSON, 45 Cortlandt St., N. Y.
Ripley & Bronson, St. Louis, Mo..... 749

PIPE AND SPECIALS (Cast Iron).

Addyston Pipe & Steel Co., Addyston, O., and Newport, Ky 747
Anniston Pipe Works, Anniston, Ala.. 745
CHATTANOOGA FOUNDRY AND PIPE WORKS, Chattanooga, Tenn.
Donaldson Iron Co., Emaus, Lehigh Co., Pa..... 747
Drummond, M. J., Corbin Building, 192 Broadway, N. Y..... 737
Fox, John, 160 Broadway, N. Y 743
GLAMORGAN IRON WORKS, Lynchburg, Va.
Gloucester Iron Works, 401 Chestnut St, Philadelphia, Pa..... 747
Jackson & Woodin Mfg. Co., Berwick, Pa 747
King & Goddard, 29 Pearl St., Boston, Mass..... .....See colored page.
Charles Millar & Son, Utica, N. Y..... xix
Mellert Foundry & Machine Co., Reading, Pa..... 743
Pancoast & Rogers, 28 Platt St., N. Y.. ix
Ripley & Bronson, St. Louis, Mo.. 749
South Pittsburg Pipe Works, South Pittsburg, Tenn..... 741
Utica Pipe Foundry, Utica, N. Y..... xix
Warren Foundry & Machine Co., 160 Broadway, N. Y..... xix
R. D. Wood & Co., 400 Chestnut St., Philadelphia, Pa..... xxiv

PIPE (Converse Lock Joint).

National Tube Works Co., McKeesport, Pa..... 725

PIPE (Lead).

Boston Lead Manufacturing Co., 162 Congress St., Boston, Mass 739
Charles Millar & Son..... xix

PIPE (Natural Gas).

National Tube Works Co., McKeesport, Pa 725

PIPE (Spiral Weld).

Spiral Weld Tube Co., 43 John St., N. Y..... xv

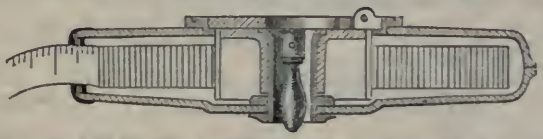
PIPE (Tin Lined).

Boston Lead Manufacturing Co., 162 Congress St., Boston, Mass..... 739

KEUFFEL & ESSER CO.
NEW YORK.

Drawing Materials and Surveying Instruments.
SUPERIOR SWISS INSTRUMENTS, SCALES, TRIANGLES, PROTRACTORS, T-SQUARES, ETC.
Paragon, Universal, Anvil, Duplex Drawing Papers in Rolls.
NORMAL, DUPLEX, UNIVERSAL DRAWING PAPERS IN SHEETS (FLAT) ALL DOUBLE ELEPHANT SIZE.
HELIOS PAPER for Blue Process.
NIGROSINE PAPER (Positive Black Process.)

Excelsior Measuring Tapes

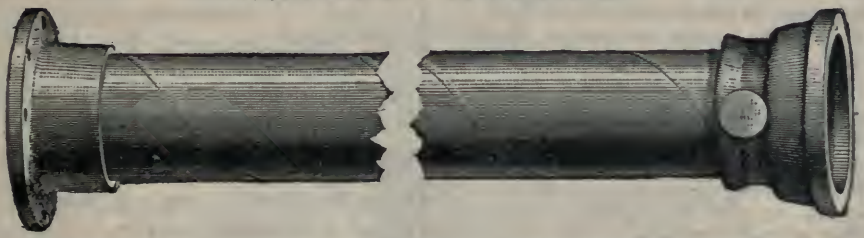


With Patent Flush Center, Steel, Metallic, Linen in Great Variety.
EVERY TAPE WARRANTED.

Leveling Rods with Thompson's Patent Angle Target to insure vertical position of rod
"STANDARD" Profile and Cross-section Papers superior to all others.
We make LEVELS, TRANSITS, PLANE TABLES, etc., of superior excellence. Correspondence invited.
Catalogues to Professional People on Application.

SPIRAL WELD STEEL PRESSURE PIPES.

HAMMER WELDED.



FLANGES AND HUBS AND SPIGOTS TO THE REGULAR STANDARD.

Practical for Water, Gas, Steam or Air, under Light or Heavy Pressures. Strong, Light, Cheap.
THE BEST PIPE MADE.

THE SPIRAL WELD TUBE COMPANY,

43 JOHN STREET, NEW YORK.

COUPLINGS FOR ALL USES.

PIPE (Vitrified).

Blackmer & Post, St. Louis, Mo..... 753

Charles Millar & Son, Utica N. Y.xix

PIPE (Wrought Iron).

King & Goddard, 29 Pearl St., Boston, Mass.....See colored page.

National Tube Works Co., McKeesport, Pa , and Boston, Mass..... 725

Pancoast & Rogers, 28 Platt St., N. Y..... ix

Spiral Weld Tube Co., 5 Beekman St., N. Y..... xv

PIPE (Wood).

King & Goddard, 29 Pearl St., Boston, Mass..... ....See colored page.

PLATE IRON WORK.

Tippett & Wood, Phillipsburg, N. J.... viii

PLUMBERS' SUPPLIES.

GENESEE IRON & BRASS WORKS, Rochester, N. Y.

JAMES, JACOB, 84 John St., N. Y.

PORTABLE DRILLING MACHINES.

Austin Mfg. Co., F. C., Chicago, Ill... 733

Oil Well Supply Co., 82 Fulton St., N. Y. 757

Pierce Artesian & Oil Well Supply Co., 80 Beaver St., N. Y..... 759

PROTECTION FOR MILLS.

CHRISTIE & LE COUNT, 351 Canal St., N. Y.

PUMPS (Copper and Iron).

Boston Lead Manufacturing Co., Boston, Mass..... 739

PUMPS.

(Diaphragm and Hand Power.)

Boston and Lockport Block Co., 162 Commercial St., Boston, Mass..... 741

Douglas, W. & B., Middletown, Conn... 741

King & Goddard, 29 Pearl St., Boston, Mass..... .....See colored page.

PUMPING MACHINERY (Steam).

Barr Pumping Engine Co., Germantown Junction, Philadelphia, Pa..... 765

Geo. F. Blake Manufacturing Co., 95 Liberty St., N. Y..... iii

Deane Steam Pump Co., Holyoke, Mass. (opposite title page).....xxii

DOW STEAM PUMP WORKS, 114 Beale St., San Francisco, Cal.

GORDON STEAM PUMP CO., Hamilton, O.

Holly Manufacturing Co., Lockport, N. Y. (opposite inside last cover)..... 766

Knowles Steam Pump Works, 111 Federal St., Boston, Mass.....inside front cover

Oil Well Supply Co., 82 Fulton St., N. Y. 757

Pond Engineering Co., 7th and Market Sts., St. Louis, Mo..... 765

Smith & Valle Co., 112 Liberty St., N. Y. 764

R. D. Wood & Co., 400 Chestnut St., Philadelphia, Pa..opposite table of contents.xxiv

Henry R. Worthington, New York (inside last cover)..... 767

RATCHET DIE STOCK.

Lowell Wrench Co., Worcester, Mass.. 757

RETORTS.

Drummond, M. J., Corbin Building, 192 Broadway, N. Y..... 737

Warren Foundry and Machine Co., 160 Broadway, N. Y..... xix

ROCK DRILLS.

Rand Drill Co., 23 Park Place, N. Y..... 729

ROUGH STOPS.

The E. Stebbins Mfg. Co., Brightwood P. O., Springfield, Mass..... 733

RUBBER GOODS.

Boston Belting Co., Boston, Mass., and 100 Chambers St., N. Y..... 745

SEWER EXCAVATING MACHINERY.

Carson Trench Machine, 21 Hamilton St., Boston, Mass..... 762

STAND PIPES AND WATER TOWERS.

R. F. Hawkins Iron Works, Springfield, Mass..... 745

Pancoast & Rogers, 28 Platt St., N. Y. ix

Pierce & Thomas, 42 Cortlandt St., N. Y..... xiii

Porter Manufacturing Co., Syracuse, N. Y..... 758

Sharon Boiler Works, Sharon, Pa..... 751

Taunton Loco. Mfg. Co., Taunton, Mass..... 763

Tippett & Wood, Phillipsburg, N. J..... 760

STEEL AND IRON WATER PIPE (Sheet).

Lacy Manufacturing Co., Los Angeles, Cal..... 743

STEAM, GAS AND WATER-WORKS SUPPLIES.

Carr, Charles, 7 Exchange Place, Boston, Mass..... 717

Hays Manufacturing Co., Erie, Pa... 711

King & Goddard, 29 Pearl St., Boston, Mass..... .....See colored page.

Charles Millar & Son, Utica, N. Y.... xix

Pancoast & Rogers, 28 Platt St., N. Y. ix

Ripley & Bronson, St. Louis, Mo..... 749

STONE CRUSHERS.

Porter Mfg. Co., Syracuse, N. Y..... 758

STREET WASHERS.

Douglas, W. & B., Middletown, Conn.... 741

Hays Manufacturing Co., Erie, Pa... 711

Ripley & Bronson, 800 N. Second St., St. Louis, Mo..... 749

STRUCTURAL WORK.

Mellert Foundry & Machine Co., Reading, Pa,..... 743

The Oldest and Largest Establishment in the United States.

"HOFFMAN"

Rosendale Cement.

Sales in the United States, 5,000,000 Barrels.

Daily Capacity, 5,000 Barrels.

We have the Largest and Best Equipped Mills, and manufacture only from the Best Rock. In competitive test it is Always Ahead. The heaviest masonry and the largest public works are built with "HOFFMAN." We publish, for free distribution, a pamphlet giving valuable information about cement.

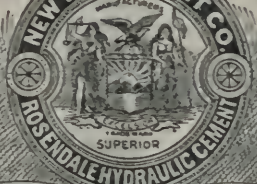
LAWRENCE CEMENT CO., 67 William St.,

M. ALBERT SCULL, ERNEST R. ACKERMAN, } General Sales Agents. NEW YORK.

POSITIVELY THE BEST.

New York Cement Company

MANUFACTURERS OF SUPERIOR



FOR USE IN ALL KINDS OF MASONRY.

AND CONCRETE, IN AND OUT OF WATER

THOMAS MILLER, President

THOMAS MILLER, JR., Secretary.

FAC-SIMILE OF LABEL ON BARREL.

ROSENDALE HYDRAULIC CEMENT.

OFFICE 18 CORTLANDT ST., (TELEPHONE BUILDING) NEW YORK.

SUBMARINE ARMOR.

Schrader & Son, A., 32 Rose St., N. Y. xxi

SUBMERGED WORK.

Holmes, A. L., Grand Haven, Mich..... 751
Thacher & Breymann, 28 Summit St., Toledo, O..... xxi

TAPES (Measuring).

Frost & Adams, 37 Cornhill St., Boston, Mass..... 739
Keuffel & Esser Co., New York..... xv

TANKS.

R. F. Hawkins Iron Works, Springfield, Mass..... 745
Lacy Manufacturing Co., Los Angeles, Cal..... 743
Pancoast & Rogers, 28 Platt St., N. Y. ix
Pierce & Thomas, 42 Cortlandt St., N.Y. xiii
Porter Mfg. Co., Syracuse, N. Y..... 758
Taunton Loco. Mfg. Co., Taunton, Mass..... 762
Tippett & Wood, Phillipsburg, N. J..... 760

TAPPING MACHINES (Water and Gas Pipe).

Charles Carr, 7 Exchange Pl., Boston, Mass..... 717
King & Goddard, 29 Pearl St., Boston, Mass.....See colored page.
Mueller Mfg. Co., H. 222 E. Main St., Decatur, Ill..... 715
Smith, A. P., 130 Halsey St., Newark, N. J. 755

TRENCHES.

Carson Trench Machine Co., Boston, Mass..... 762

TURBINE WHEELS.

LEFFELL & CO., JAS., 110 Liberty St., N. Y.
Mellert Foundry & Machine Co., Reading, Pa..... 743
R. D. Wood & Co., 400 Chestnut St., Philadelphia, Pa..... xxiv

TUBULAR GOODS (R. R.).

National Tube Works Co., McKeesport and Boston..... 725

TURNTABLES.

Tippett & Wood, Phillipsburg, N. J..... 760

VALVES.

Ashton Valve Co., 271 Franklin St., Boston, 107 Liberty St., New York and 218 Lake St., Chicago..... 705
Bourbon Copper & Brass Works, 198 East Front St., Cincinnati, O..... 727
Chapman Valve Co., Boston and Chicago (opposite preface)..... xxvi
Drummond, M. J. 192 Broadway, N. Y... 737
Eddy Valve Co., Waterford, N. Y..... xx
Fairbanks & Co., 311 Broadway, N. Y..... xi
Fox, John, 160 Broadway, N, Y..... 743
Galvin Brass & Iron Works, Detroit, Mich..... 761
Gloucester Iron Works, 401 Chestnut St., Philadelphia, Pa..... 747

VALVES.—Continued.

Hays Manufacturing Co., Erie, Pa. 711
Kennedy, D. 52 Cliff St., N. Y..... 727
Ludlow Valve Mfg. Co., 938 River St., and 67 Vail Ave., Troy, N. Y..... 713
Mellert Foundry & Machine Co., Reading, Pa..... 743
Millar & Son, Charles, Utica, N. Y.....xix
Pancoast & Rogers, 28 Platt St., N. Y... ix
Peet Valve Co., 163 Albany St., Boston, Mass..... v
Rensselaer Mfg. Co., Troy, N. Y..... 709
Ripley & Bronson, 800 N. Second St., St. Louis, Mo..... 749
R. D. Wood & Co., 400 Chestnut St., Phil. Pa.....xxiv

VALVES (Locked "Pop" Safety).

Ashton Valve Co., Boston, Mass..... 705

VALVES (Rubber).

Boston Belting Co., Boston, Mass..... 715

VALVES (Stand Pipe).

E. L. Dent's Iron Works, Georgetown, D. C..... xxi

VALVES (Steam Yacht).

Ashton Valve Co., Boston, Mass..... 705

VALVES (Water Relief).

Ashton Valve Co., Boston, Mass..... 705

WATER GATES.

Lacy Manufacturing Co., Los Angeles, Cal..... 743

WATER-WORKS SECURITIES.

Coffin & Stanton, 72 Broadway, N. Y.... 749
GILLIGAN, H. M., 64 Broadway, N. Y.
Kean & Co., S. A., Chicago and New York..... xiii
Loring, S. D., 89 State St., Boston, Mass.. xxi
Venner & Co., C. H., Boston, Mass. (outside back cover).

WATER PRESSURE REGULATORS.

HINE & ROBERTSON, 45 Cortlandt St., N. Y.
Mueller Mfg. Co., H. Decatur, Ill..... 715
Union Water Meter, Co., Worcester, Mass..... 719

WELL CASINGS AND TUBING.

Lacy Manufacturing Co., Los Angeles, Cal..... 743
National Tube Works Co., McKeesport, Pa..... 725
Oil Well Supply Co., 82 Fulton St., N. Y. 757
Pancoast & Rogers, 28 Platt St., N. Y. ix

WELL MAKING MACHINERY.

F. C. Austin Mfg. Co., Chicago, Ill..... 733
Pierce Artesian & Oil Well Supply Co., 80 Beaver St., N. Y..... 759
Oil Well Supply Co., Limited, 82 Fulton St., New York..... 757

WATER POWER (See Mills).

WRENCHES (Ratchet).

Lowell Wrench Co , Worcester, Mass... 757

NEW YORK AND ROSENDALE CEMENT COMPANY
ROSENDALE HYDRAULIC CEMENT.
Office 229 BROADWAY NEW YORK.
HIRAM SNYDER SECRETARY.

Warranted Superior

TO ANY

ROSENDALE HYDRAULIC CEMENT

MANUFACTURED.

USED ON THE

Most Important Works

IN THE COUNTRY.

Send for Pamphlets on Tests and Testimonials.

UTICA PIPE FOUNDRY CO.

CAST IRON PIPE AND SPECIALS FOR WATER AND GAS.

Also Flanged Pipe & Fittings, Hydrants, Gates, Pig Lead, Etc.

CHAS. MILLAR & SON, Selling Agents,

UTICA, N. Y.,

Manufacturers of Lead Pipe; Wholesale Eastern Agents for Akron Vitrified Sewer Pipe.

WARREN FOUNDRY & MACHINE CO.,

ESTABLISHED 1856.

Works at Phillipsburg, N. J.

NEW YORK OFFICES,

No. 160 BROADWAY.

WILLIAM RUNKLE,
Selling Agent.

CAST IRON WATER AND GAS PIPE
From 3 to 48 inches diameter.

ALL SIZES OF

FLANGE PIPE

FOR

Mines and Sugar Houses.

Branches, Bends, Retorts, etc.

THE EDDY VALVE CO.,

WATERFORD, N. Y.

MANUFACTURERS OF

Single and Double Gate, Sluice, Check, and Foot

VALVES,

½IN. TO 56 INS.

VALVES

with Sliding Stems and Levers, Outside Stems and Yokes, Gears, Indicators, Boxes, etc. for Water, Steam, Oil, Gas and Ammonia Purposes.

EDDY

Yard, Wash and Fire

Hydrants.

G. W. BRAMWELL, C. E. W. DE H. WASHINGTON. H. DE C. RICHARDS, Genl. Mgr.

THE HYDRAULIC CONTRACTING COMPANY,

ENGINEERS AND CONTRACTORS,

Build and Maintain Water-Works by Franchise and Contract.

SPECIALTY: Water Supply by Driven, Ganged, Tube and Artesian Well Systems for Cities, Towns, Railroads and Manufacturers.

120 Broadway, - - New York.

EQUITABLE BUILDING.

S. D. LORING,

Investment Securities,

Water Company Bonds a Specialty.

FISKE BUILDING,

89 State Street,

BOSTON.

ESTABLISHED 1844.

A. SCHRADER & SON,

MANUFACTURERS OF

Submarine Armor

AND

Diving Apparatus.

32 ROSE ST., NEW YORK.

IMPROVED BOLT HELMET.

E. L. DENT'S

IRON WORKS

GEORGETOWN, D. C.

Manufacturer of

Hayden's Fire and Street Hydrants,

Stand Pipe Valves.

Architectural Iron Work of all Kinds.

HOT WATER and STEAM HEATING.

ENGINEERING NEWS

AND

AMERICAN RAILWAY JOURNAL.

PUBLISHED WEEKLY. SIXTY PAGES.

SUBSCRIPTION PRICE { $5 per Annum. $2 for Four Months.

ENGINEERING NEWS contains each week twenty-four pages of valuable reading matter, covering the entire field of engineering science in both this and foreign countries. Railways, water-works, manufacturing and technical, contracting, and mechanical and electrical industries are fully reported, and detailed working drawings and full descriptions are given of all the more important and noteworthy structures and enterprises. Record is kept of the proceedings of all the engineering and technical societies and clubs, and the latest technical books and magazines are fully reviewed and discussed. The correspondence columns contain communications from engineers, contractors and others, regarding matters of current interest.

The advertising columns and those of "News of the Week" constitute the most complete record of the current contract work of engineering in the United States that is obtainable. Together they make a very complete index of new railroads, new water-works, sewer building, street paving, highways, river and harbor improvement, bridge construction, public buildings erected, tunneling, pile driving, dredging, blasting operations, experiments and actual work in concrete and cement, electricity and gas, artesian wells, canals, everything, in fact, having any relation to public works, or the business of civil engineering and contracting, while from the abstracts of bids published from week to week, the prices of labor, materials and other elements of cost of engineering work in different parts of the country are obtainable. Address

ENGINEERING NEWS PUBLISHING CO.,
Tribune Building, New York.

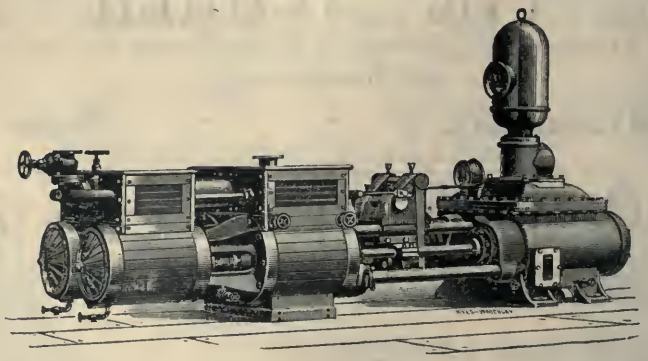
THACHER & BREYMANN,

Submarine Engineers and Divers.

Contractors for Submarine work of all kinds where divers are required.
Recovering sunken property.
Laying Submerged Pipes for Water, Gas and Sewerage a Specialty.
Estimates and Consultation promptly given. Correspondence solicited.
Office, No. 28 Summit St., Toledo, Ohio.

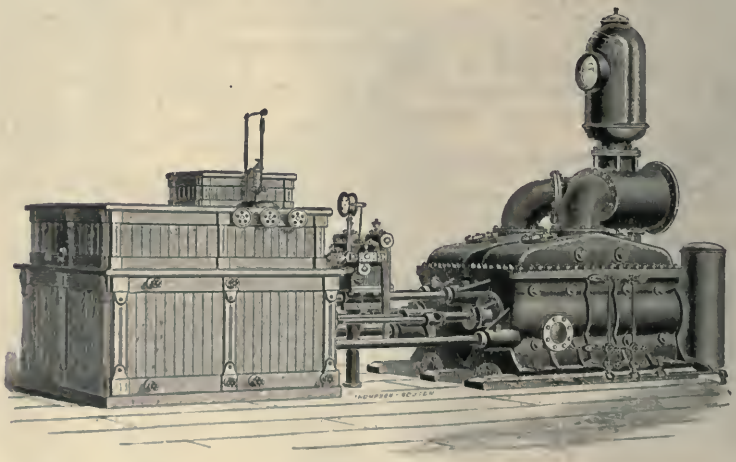
THE DEANE

WATER-WORKS ENGINES.



PUMPING MACHINERY

OF EVERY VARIETY.



THE DEANE STEAM PUMP CO.

HOLYOKE, MASS.

OFFICES AND WAREROOMS:

New York, Boston, Chicago, St. Louis, Denver, Philadelphia, Birmingham.

Write for Catalogue.

P
Technol
M

SECOND ANNUAL ISSUE.

The Manual

OF

American Water-Works

COMPILED FROM SPECIAL RETURNS.

Containing the History, Details of Construction, Source and Mode of Water Supply, Pumping Machinery, Dams and Reservoirs, Filters, Distribution, Consumption, Pressure, Hydrant Rental, Revenue and Expenses, Cost and Debt, etc., etc., of Every Water-Works in the United States and Canada.

WITH SUMMARIES
For Each State and Group of States;

FAMILY AND METER WATER RATES
Charged in 800 Cities;

AND DIRECTORY
Of Water-Works Officials, Engineers and Contractors.

THIRTY ILLUSTRATIONS OF DAMS AND RESERVOIRS.

M. N. BAKER, PH. B., EDITOR.

Physical &
Applied Sci.
Serials

1889-90.

96419A
1/6/09

ENGINEERING NEWS PUBLISHING CO.,
TRIBUNE BUILDING, NEW YORK.
1890.

COPYRIGHT 1890, BY THE ENGINEERING NEWS PUBLISHING CO.

R. D. Wood & Co.

Engineers,

Iron Founders,

and Machinists.

Office: 400 Chestnut Street, Philadelphia,

Foundries and Works: Millville, Florence, Camden, N. J

Constructors of Water & Gas Works.

MANUFACTURERS OF

CAST IRON PIPE,

—OF ALL KINDS AND SIZES.—

TURBINE WHEELS.

Pumping Machinery,

Hydraulic Cranes,

Lifts and Machinery,

Heavy Loam Castings,

"Eddy" Valves,

"Mathews" Hydrants.

Iron Floors, Roofs AND Girders.

CONTENTS.

PAGE.

Advertisements ..... II.

Abbreviations (*Following Preface*).

Introduction ..... XXIX.

Water-works completed, in process of construction, projected, or reported projects since become indefinite in

United States.

Alabama 332
Arizona 642
Arkansas 566
California 614
Colorado 587
Connecticut 105
Delaware 287
District of Columbia 297
Florida 328
Georgia 321
Idaho 648
Illinois 431
Indiana 358
Indian Territory 587
Iowa 476
Kansas 504
Kentucky 352
Louisiana 342
Maine 1
Maryland 289
Massachusetts 34
Michigan 402
Minnesota 495
Mississippi 339
Missouri 554
Montana 551
Nebraska 527
Nevada 643
New Hampshire 16
New Jersey 195
New Mexico 601
New York 126
North Carolina 314
North Dakota 546
Ohio 359
Oregon 602
Pennsylvania 217
Rhode Island 96
South Carolina 319
South Dakota 534
Tennessee 343
Texas 571
Utah 646
Vermont 27
Virginia 299
Washington Territory 603
West Virginia 311
Wisconsin 460
Wyoming Territory 548

Dominion of Canada.

British Columbia 681
Manitoba 680
New Brunswick 649
Newfoundland 656
Northwest Territory 681
Nova Scotia 652
Ontario 664
Prince Edward Island 656
Quebec 657

Group 1—New England States 1
2—Middle " 126
3—South Atlantic " 299
4—South Central " (Gulf & Mississippi Valley) 332
5—Middle States 352
6—Northwestern States 476
Group 7—Southwestern " 554
8—Pacific " 603
9—Canadian Maritime Provinces 649
10—Canadian Interior and Western Provinces 657

Family and Meter Water Rates, with Cost of Works per Family 685
Advertisements 705
Directory of Water-Works Superintendents, Secretaries, Engineers and Contractors 708

ILLUSTRATIONS.

[R. denotes reservoir, and where the letter is not used the structure is a dam; T. denotes timber; M., masonry; E., earth; P., plan; S., section; E., elevation.]

Bangor, Me. ..... T. 2
Portland, Me. ..... M. S. 10
" " ..... R. E. S. 11
Manchester, N. H. ..... R. E. P. S. 22
Windsor, Vt. ..... E. S. 33
Brockton, Mass. ..... E. S. 43
Cambridge, Mass. ..... E. P. S. 45, 46
Fitchburg, " ..... E. P. 53
New Bedford, " ..... E. S. 70
Quincy, " ..... E. S. 77
Pawtucket, R. I. ..... E. S. 99, 100
Bridgeport, Conn. ..... M. P. S. 108
" " ..... Tunnel 109
West Haven, " ..... M. S. E. 124
Waterville, N. Y. ..... E. S. 189
Bound Brook, N. J. (2) ..... M. P. E. 198, 199
Newark, N. J. (3) ..... R. F. S. 208
Nashville, Tenn. ..... R. M. P. S. 349
Hudson, Wis. (cov'd) ..... R. M. P. S. 465
Winfield, Kan. ..... R. E. P. 526
Pierre, So. Dak. (cov'd) ..... R. M. S. 542
St. Louis, Mo. ..... R. E. S. 563
Dallas, Tex. ..... R. E. P. 574
National City, Cal. (Sweetwater) ..... M. View 624
Redlands, Cal. (Bear Valley) ..... M. P. S. E. 631
Montreal, P. Q. ..... R. E. & M. S. 660
Quebec, " ..... M. S. 660
London, Ont. ..... R. E. S. 669
Toronto, " ..... R. E. S. 677

CHAPMAN VALVE MANUFACTURING CO.,

MANUFACTURERS OF

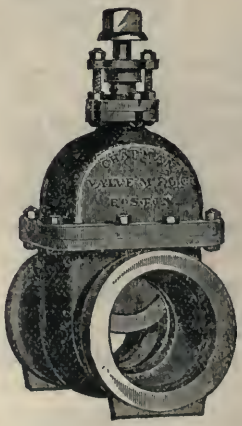
VALVES AND GATES

For Water, Gas, Steam, Oil, Acid, Ammonia, Etc.

FIRE HYDRANTS

WITH OR WITHOUT

INDEPENDENT NOZZLE VALVES.



GENERAL OFFICE AND WORKS:

INDIAN ORCHARD, MASS.

TREASURER'S OFFICE:

72 KILBY STREET, BOSTON.

ALL WORK GUARANTEED.

24 West Lake Street, - - - - Chicago, Ill.

PREFACE.

This volume contains revised descriptions of all the water-works included in the first issue, together with 310 new works, or 2,047 in all. Official reports for the year closing Jan. 1, 1889, have been received for nearly all the old works, and in each case where, after several requests, the officials have failed to respond, the latest previous returns have been included, with the year to which they apply placed in parenthesis. In the case of new works the date of the latest report has been stated at the close of each description. All works completed prior to March 1, 1890, so far as could be ascertained by the most systematic and persistent inquiry, and many works under construction at that time, or upon which work has been commenced since, are included and described as fully as our reports would permit.

More or less data has been secured and is presented at the close of each State regarding what may well be termed projects of promise. There are 258 of these in the United States and Canada, many of which are now rapidly developing, and some of which have been already put under construction.

Much matter has been added to the former descriptions of the various works, especially regarding dams and reservoirs, some 30 of which are illustrated in the present volume. Most of the latter information and illustrations have been secured by sending a special blank to each water-works having dams and reservoirs, asking for information concerning them. We have also added to the description of each plant, whenever we could secure the information, a statement as to whether the city or town in question had electric lighting and sewerage systems. It is surprising to note that less than 600 towns report a sewerage system.

Perhaps the most important new matter is that given in the back of the book, the family and meter water rates of nearly 800 cities. These have been carefully averaged by States, the averages being for all works, for private works and for public works. Some of the averages are continued in the Introduction by groups of States for the whole United States and for Canada. Such a comparison of rates charged for water furnished by public and by private works has never before been made, and never before have so many rates been made available to the public in one collection. The rates and the deductions from them furnish a most important aid to the consideration of private vs. public ownership of water-works and other natural monopolies.

The delay in the appearance of this volume has been largely caused by the difficulty experienced in securing some of the returns and by the extra labor involved in collecting, compiling and summarizing the new matter.

We most heartily thank all who have in any way aided in securing the accompanying data. With but one exception the originals of all the illustrations have been furnished us by the engineers or water-works officials connected with the structures, either for use in the MANUAL or in ENGINEERING NEWS, and we especially thank them for this kindness. The exception mentioned applies to the reservoir at Manchester, N. H., the illustrations for which were reproduced from Mr. J. T. Fanning's *Treatise on Water Supply Engineering.*

For the sake of convenience and brevity the abbreviations on the following page are used in the MANUAL.

M. N. BAKER, *Editor.*

TRIBUNE BUILDING, New York, July, 1890.

ABBREVIATIONS.

Ann. op. exp. Annual operating expenses.
Ann. rev. Annual revenue.
Asst. Engr. Assistant Engineer.
Av. Average.
Av. dy. Average daily.
Cap. Capacity.
cem. cement.
c. i. cast-iron.
Com. Committee.
Comr. Commissioner.
Co. Company.
Const. Engr. Constructing Engineer.
Consult. Engr. Consulting Engineer.
Contr. Contractor.
Co. County.
Dy. cap. Daily capacity.
Des. Engr. Designing Engineer.
diam. diameter.
Engr. Engineer.
est. estimated.
ft. feet.
gall. gallons.
galv. i. galvanized iron.
Gen. Mgr. General Manager.
H.-P. Horse-Power.
Imp. Imperial.
in. inches.
Incorp. Incorporated.
Int. Interest.
kal. i. kalamein iron.
lbs. pounds.
Mgr. Manager.
p. page.
pp. pages.
Pop. Population.
Prest. President.
Pumpg. Engr. Pumping Engineer.
Secy. Secretary.
sq ft. square feet.
Sub-contr. Sub-contractor.
Supt. Superintendent.
Treas. Treasurer.
V.-Prest. Vice-President.
vol. volume.
w. i. wrought iron.

The Manual

OF

American Water-Works.

1889-90.

INTRODUCTION.

The second annual issue of the MANUAL OF AMERICAN WATER-WORKS has been compiled on practically the same lines as the first volume, but the descriptions of the various works have been greatly amplified, particularly the data relating to dams and reservoirs. Special reports have been secured regarding many of these structures, which, with several illustrations, are included in this volume and cannot fail to add greatly to its value. Another notable feature of the 1889-90 MANUAL is the collection of family and meter water rates given at its close. As a matter of interest and importance it is stated in connection with the description of each works, so far as possible, whether the city or village under consideration has a sewerage system, and in the same connection it is also stated whether electric lighting is in use.

Very complete summaries were given in the introduction to the last MANUAL, most of which are omitted from this volume, as it has seemed advisable to present instead entirely new matter and, besides, extended studies could not well be made without the use of the new census populations, which have not been compiled at the time this goes to press.

The various States and Provinces are arranged in the same groups as in the last MANUAL, viz. :

GROUP 1. (*A*)—*New England States.* Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut.

GROUP 2. (*B*)—*Middle States.* New York, New Jersey, Pennsylvania, Delaware, Maryland and District of Columbia.

GROUP 3. (*C*)—*South Atlantic States.* Virginia, West Virginia, North Carolina, South Carolina, Georgia and Florida.

GROUP 4. (*D*)—*South Central States.* (Gulf and Mississippi Valley.) Alabama, Mississippi, Louisiana, Tennessee, Kentucky.

GROUP 5. (*E*)—*North Central States.* Ohio, Indiana, Michigan, Illinois, Wisconsin.

GROUP 6. (*F*)—*Northwestern States.* Iowa, Minnesota, Kansas, Nebraska, South Dakota, North Dakota, Wyoming, Montana.

GROUP 7. (*G*)—*Southwestern States.* Missouri, Arkansas, Texas, Indian Territory, Colorado, New Mexico.

GROUP 8. (*H*)—*Pacific States.* Washington, Oregon, California, Arizona, Nevada, Utah, Idaho.

To this, which includes the whole United States, there is added:

GROUP 9. (*I*)—*Canadian Maritime Provinces.* New Brunswick, Nova Scotia, Prince Edward Island, Newfoundland. (Newfoundland is not practically a part of the Dominion of Canada, but geographically it belongs with Canada.)

GROUP 10. (*J*)—*Canadian Interior and Western Provinces.* Quebec, Ontario, Manitoba, Northwest Territory and British Columbia.

THE WATER-WORKS OF THE UNITED STATES AND CANADA.

This issue of the MANUAL includes descriptions of 2,047 works, 1,960 of which are in the United States, 83 in Canada and four in Newfoundland. Of these, 77 in the United States and three in Canada, or 80 in all, are subsidiary works; that is, take their water supply from some other plant, but are otherwise independent. Several plants extend throughout two or more villages or cities, this being especially true in Maine, Rhode Island and New Jersey. A few towns have duplicate plants, but these are not common, and are far less in number than the duplicate gas and electric lighting plants in this country.

The recent comparative growth of the water-works industry in different sections is shown below by groups of States. The period covered is about 14 months, but the dates must be understood to be only approximate, as it is practically impossible to say how many water-works were actually completed in so large a territory on a given day. As showing the comparative growth in the different groups, however, the following figures are fairly correct:

	N. E.	Mid.	So. Atl.	So. C.	No. C.
1888	304	463	74	57	338
1889	325	509	92	71	377
Increase	21	46	18	14	39
P. C. of Inc	6.9	9.9	24.3	24.6	11.5

	N. W.	S. W.	Pac.	Total. U. S.	Canada.
1888	229	141	143	1,749	76
1889	268	152	166	1,960	87
Increase	39	11	23	211	11
P. C. of Inc	17	7.8	16.1	12.1	14.5

The relative increase will be most quickly grasped by examining the percentages ranged by groups in a descending scale:

South Central	24.6	Total United States	12.1
South Atlantic	24.3	North Central	11.5
Northwestern	17	Middle	9.9
Pacific	16.1	Southwestern	7.8
Canada	11.5	New England	6.9

The sections of the country showing greatest increase are those which until recently have been backward in water-works construction, while the New England and Middle States, with but slight increase, have for some time had a large number of works. The small gain in the Southwestern group can be understood when it is remembered that the States included are Missouri, Arkansas, Texas and Colorado, with Indian and New Mexico Territories. The Territories are extremely backward and the States are at present rather slow in their development, except in limited parts of their areas. Besides this, the larger towns have been quite generally supplied for a few years, and the growth for the last 20 years is quite as marked as in any section of the country, the number increasing from one in 1870 to 22 in 1880, and from the last number to 152 in 1889. In Colorado and slightly in Texas irrigating companies make accessible to many of the smaller towns a supply of running water near at hand so that it is not necessary to pipe it to the houses. If this is an effective cause in retarding the growth of water-works built wholly for domestic supply, it applies equally to the Northwestern and Pacific groups, and to their advantage, as notwithstanding this they have made great gains in numbers.

TABLE 1—S.

UNITED STATES AND CANADIAN WATER-WORKS—SUMMARY OF DATES OF CONSTRUCTION BY GROUPS OF STATES.

[Date of completion taken when construction extended over more than one year.]

Year.	WATER-WORKS BUILT. N.E.	Mid.	S. Atl.	So. C.	N. C.	N. W.	S. W.	Pac.	Total U. S.	Canada.
B'forc 1800	1	3	1	..	..	..	..	..	5	..
800-10..	3	6	..	..	..	..	.	..	9	1
1810-20..	2	1	..	..	1	..	..	..	4	..
1821-30..	1	5	3	1	1	..	1	1	13	..
1831-40..	3	3	3	6	3	..	..	1	19	1
1841-50..	3	12	1	1	2	..	.	..	19	4
1851.. .	1	3	..	..	..	..	..	..	4	
1852.....	1	4	..	..	..	..	..	..	5	
1853.....	..	2	..	..	..	..	..	2	4	1
1854..... (1)	2	3	1	..	..	..	..	..	(1) 6	..
1855.....	4	2	..	..	..	..	..	..	6	.
1856. ...	1	3	1	..	1	..	..		6	1
1857.....	2 (1)	5	..	..	..	..	..	1	(1) 8	..
1858.....	..	2	2	..	..	..	..	1	5	..
1859. ...	1	5	..	..	..	..	..	2	8	1
1860..... (1)	2	4	..	1	2	..	..		(1) 9	1
1861.....	1	3	..	..	..	..	..	1	. 5	..
1862.....	3	..	..	..	1	..	.	3	.. 7	..
1863.....	..	..	..	..	..			..	.. ..	1
1864.....	1	1	..	1	..	..	..	1	.. 4	..
1865.....	1	2	..	..	.	..	..	5	.. 8	.
1866. ...	2	3	..	..	1	..	..	2	8	
1867..... (1)	2	5	..	1	.	1	..	1	(1) 10	
1868..... (1)	4	6	..	1	2	..	..	2	(1) 15	
1869..... (1)	9	4	..	..	5	..	..	2	(1) 20	
1870. ... (3)	5	10	..	1	9	2	.	2	(3) 29	1
1871..... (1)	2	16	1	..	6	2	1	7	(1) 35	
1872.....	8	13	1	2	8	..	1	1	34	1
1873.....	15	12	1	2	13	..	1	5	49	3
1874.....	7 (1)	12	1	..	9	2	1	6	(1) 38	2
1875.....	9 (2)	14	2	..	9	2	3	4	(2) 43	2
1876..... (1)	10 (1)	13	2	1	11	(1) 5	1	5	(3) 48	3
1877.....	3 (1)	4	1	..	4	1	..	(1) 2	(2) 15	1
1878..... (1)	6	11	2	..	(1) 4	4	2	(1) 2	(3) 31	2
1879..... (1)	9	14	..	2	19	3	6	(1) 1	(2) 45	2
1880..... (1)	6	9	2	1	6	4	5	5	(1) 38	(1) 2
1881..... (1)	8	10	2	1	7	6	4	2	(1) 40	3
1882..... (3)	9 (6)	14	4	1	(1) 22	13	9	9	(10) 81	5
1883. ... (1)	9 (3)	23	2	2	16	19	14	4	(4) 89	4
1884..... (1)	22 (3)	24	1	1	18	20	17	7	(4) 110	(1) 4
1885..... (3)	18 (1)	28	5	1	26	9	12	4	(4) 103	
1886..... (2)	19 (2)	32	7	6	(1) 37	25	11	5	(5) 142	5
1887..... (7)	25 (1)	37	8	5	(1) 32	39	15	13	(9) 174	7
1888..... (2)	23 (3)	37	18	18	66	63	(1) 32	27	(6) 284	(1) 12
1889..	19 (3)	39 (1)	16 (1)	12	38	(1) 38	10	22	(6) 194	7
Unkn'n (1)	9 (3)	19	3	2	3	8	5	5	(4) 54	7
Totals (34)	291 (31)	478 (1)	91 (1)	70	(4) 373	(2) 266	(1) 151	(3) 163	(77) 1,883	(3) 84

Subsidiary water-works, viz.: those which derive their supply from the mains of some other adjacent works, but are otherwise independent systems, are enumerated above in parentheses.

Canada in this and the following tables includes 4 Newfoundland works.

The growth of the water-works interest from the start is shown in detail by Tables 1 to 3-S. Table 1-S gives the number of works built in each group prior to 1800, and in each decade since then to 1850, then by years to the present time. Table 2-S gives the same for decades to 1850 and for half decades since, and Table 3-S shows the total number of works in each group at the close of each decade.

It will be seen by examining Table 1-S that there were in 1800 five works in the United States, all in the first three groups, and that each decade to

1850, and each year thereafter, excepting 1863, has given an increase to the number. The total number of works built during the war period, 1861-5, was but 24, or only two-thirds as many as were built in the preceding five years, while in one of the war years, 1863, water-works construction was entirely suspended.

TABLE 2—S.

UNITED STATES AND CANADIAN WATER-WORKS—SUMMARY OF CONSTRUCTION BY GROUPS OF STATES, DECADES AND HALF DECADES.

[Date given is that of completion of works.]

Date.	N.E.	Mid.	S. Atl.	S. C.	N. C.	N. W.	S. W.	Pac.	Total U. S.	Canada
B'fore 1800	1	3	1	..	..	..	..	..	5	..
1800-10..	3	6	..	..	.	..	..	..	9	1
1811-20..	2	1	..	..	1	..	.	..	4	..
1821-30..	1	5	3	1	1	..	1	1	13	..
1831-40..	3	3	3	6	3	..	..	1	19	1
1841-50..	3	12	1	1	2	.	..	..	19	4
1851-55..	(1) 8	14	1	..	..	..	..	2 (1)	25	1
1856-60 .	(1) 6 (1)	19	3	1	3	..	..	4 (2)	36	3
1861-65..	6	6	..	1	1	..	..	10	24	1
1866-70..	(6) 22	28	..	3	17	3	..	9 (6)	82	1
1871-75..	(1) 41 (3)	67	6	4	45	6	7	23 (4)	199	8
1876-80..	(4) 34 (2)	51	7	4 (1)	35 (1)	17	14	(3) 15 (11)	177	(1) 10
1881-85..	(9) 66 (13)	99	14	6 (1)	89	67	56	26 (23)	423	(1) 16
1886-'9..	(11) 86 (9)	145	(1) 49	(1) 41 (2)	173 (1)	165 (1)	68	67 (26)	794	(1) 31
Unk'wn	(1) 9 (3)	19	3	2	3	8	5	5 (4)	54	7
	(34) 291 (31)	478	(1) 91	(1) 70	(4) 373	(2) 266	(1) 151	(3) 163	(77) 1,883	(3) 84

TABLE 3—S.

UNITED STATES AND CANADIAN WATER-WORKS—NUMBER OF WORKS BY GROUPS OF STATES AT THE END OF EACH DECADE.

1800.....	1	3	1	..	..	..	..	..	5	..
1810.....	4	9	1	..	..	..	.	..	14	1
1820.....	6	10	1	..	1	..	..	..	18	1
1830.....	7	15	4	1	2	..	1	1	31	1
1840.....	10	18	7	7	5	..	1	2	50	2
1850. ...	13	30	8	8	7	..	1	2	69	6
1860..... (2)	27 (1)	63	12	9	10	..	1	8 (3)	130	10
1870..... (8)	55 (1)	97	12	13	28	3	1	27 (9)	236	12
1880.....(13)	130 (6)	215	25	21 (1)	108 (1)	26	22 (3)	65 (24)	612	(1) 30
1889.....(34)	291 (31)	478	(1) 91	(1) 70 (4)	373 (2)	266 (1)	151 (3)	163 (77)	1,883	(3) 84

In the South Atlantic States from 1859 to 1870 inclusive, 12 years, not a single water-works was built. In the Northwestern group the first plant was constructed in 1867, while in the Southwestern States save one between 1821 and 1830, not a single plant was built until 1871. The marvellous growth in this section since 1871 has been commented on above.

The number of works in Canada at the end of each decade is shown in more detail by provinces as follows:

	At the end of—					In
	1850.	1860.	1870.	1880.	1885.	1889.
In Ontario	2	4	5	14	21	41
Quebec	1	2	2	10	14	19
Manitoba	..	..	..	..	1	1
British Columbia	..	..	..	..	.	4
New Brunswick	1	2	2	3	5	6
Nova Scotia	1	1	1	2	4	11
Prince Edw. Isl'd	..	..	..	..	..	1
Total, Dominion of Canada.	5	9	10	29	45	83
Newfoundland	1	1	2	2	3	4

Perhaps the most interesting of these three tables is the last one, 3-S, which shows the number of works in each group and in Canada, and the total in the United States at the end of each decade. The increase and

percentage of increase in each decade, including subsidiary works, for the United States and Canada is:

Decade closing in	No in U. S.	Inc.	P. C. of Inc.	No. in Canada.	Inc.	P. C. of Inc.
1800	5					
1810	14	9	180	1		
1820	18	4	29	1	0	
1830	31	13	72	1	0	
1840	50	19	61	2	1	100
1850	69	19	38	6	4	200
1860	133	64	93	10	4	67
1870	245	112	84	12	2	20
1880	636	391	160	31	19	158
1889	1,960	1,324	208	87	46	150

These figures need no comment. The remarkable growth of the water-works interest is very graphically shown by means of a colored diagram, and in connection with that of railways, in ENGINEERING NEWS for April 27, 1889.

While modes of supply vary largely with local or sectional conditions there is considerable latitude for choice in this respect. Table 4-S shows the number of gravity and pumping works in each group, and the number where the mode of supply is unknown, with the percentage of each to the total. The New England and Pacific States have almost exactly the same

TABLE 4—S.

UNITED STATES AND CANADIAN WATER-WORKS—MODE OF SUPPLY.

	Gravity.		Pumping.		Unknown.		
	Number.	P. c. of Total.	Number.	P. c. of Total.	Number.	P. c. of Total.	Total.
New England	154	52	135	45.6	7	2.4	296
Middle	197	41.5	267	56.4	10	2.1	474
So. Atlantic	17	18.5	71	77.2	4	4 3	92
So. Central	6	8.4	60	84.5	5	7.1	71
No. Central	17	4.5	356	93.9	6	1.6	379
Northwestern	27	10.1	236	88.4	4	1.5	267
Southwestern	33	20.6	125	78.1	2	1.3	160
Pacific	94	52.2	82	45.6	4	2.2	180
Total U. S.	545	28.4	1,332	69.4	42	2.2	1,919
Canada	32	36 4	53	60 2	3	3.4	88

percentage of gravity works, 52 and 52.2 per cent, respectively, and the North Central States with 4.5 per cent, and the South Central with 8.4 per cent have the smallest percentage. Some works have two or more systems, and of course the subsidiary works are not included in the table. In the MANUAL for 1888 the pumping works are summarized in more detail, the number and percentages of works pumping to tanks, standpipes, reservoirs and direct being given.

One of the most earnestly discussed questions of the day is whether natural monopolies should be owned and controlled by public or private corporations. Among these natural monopolies are gas and electric lighting plants, street railways and water-works. So far as we are aware, there are in the United States or in Canada no street railways owned by municipalities; but a large majority of voters of the city of Toronto recently voted in favor of the purchase by the city of the street railways within its limits. There are in the United States at least three and probably four or five gas works owned and operated by municipalities out of a total of about 1,000 plants. Of some 1,300 or more electric lighting plants in this country, at least 50 are owned by the city in which they are located. When we consider water works we see a far different state of affairs, as is shown in Table 5-S. From this table it appears that

of the 1,960 water-works in the United States 818, or 41.7 per cent., are owned by public corporations, and 1,106, or 56.4 per cent., by private corporations, the ownership of the remaining number being unknown. In Canada the showing for public works is still better, there being 57.1 per

TABLE 5—S.

UNITED STATES AND CANADIAN WATER-WORKS—OWNERSHIP.

	N. E.	Mid.	So. Atl.	So. C.	No. C.	N. W.	S. W.	Pac.	Total. U. S.	Canada.
Public.	133	154	47	13	244	150	51	26	818	48
Private.	191	323	45	58	131	118	100	140	1,106	35
Unknown.	1	32	..	..	2	...	1	...	36	1
Total.	325	509	92	71	377	268	152	166	1,960	84
Percentage of each to total.										
P. c. of Pub.	40.9	30.3	51.1	18.3	64.7	56	33.5	15.7	41.7	57.1
P. c. of Priv.	58.8	63.4	48.9	81.7	34.8	44	65.8	84.3	56.4	41.7
P. c. of Unk'n.	.3	6.3	....	....	.5	..	.7	....	1.9	1.2

cent. public to 41.7 per cent. private, 1.2 per cent. of the total number being of unknown ownership. If we take sections of the country we find a wide difference, the North Central group of States having 64.7 per cent.; the Northwestern, 56 per cent., and the Pacific States but 15.7 per cent. of public works.

The number of public and private works in each State, and the population on each class of works, was given in the MANUAL for 1888. It may be said here that in some States the ownership is almost wholly public, in others private, and that the larger cities are supplied by public works, only about one-third of the population on water-works depending upon private companies for their supply.

Perhaps the most accurate index of the recent growth of water-works is the increase in the miles of water mains. This is shown for each State and group of states by Table 6-S. The first column gives the mileage at the close of 1888, as shown in our last summary, but as this did not include those works described in the Supplement to the 1888 MANUAL, nor a few works built in or prior to 1888, but not reported soon enough for description until the present issue, it has been necessary to correct the previous mileage by means of columns two and three. It should be noted that the fourth column gives the extensions made to old works in the year 1888, the mileage of old works being necessarily for one year back in each case, and the fifth the mileage of new works. Further than this the table needs no explanation.

TABLE 6—S.

UNITED STATES AND CANADIAN WATER-WORKS—MILES OF MAINS BY STATES AND GROUPS OF STATES.

State.	1888 record.	Add.	Extensions Actual, 1888.	Extensions to old works.	Extensions New works.	Total, 1889.	Inc. in 1889.
Maine	505.95	9	513.95	23.02	23	560.97	47.02
New Hampshire	327.21	10	337.21	71.27	9	417.48	80.27
Vermont	176.01	9.5	185.51	22.09	7.5	215.1	29.59
Massachusetts	3,072.78	16	3,088.78	187.89	60	3,336.67	247.89
Rhode Island	443.35	...	443.35	35.49	...	478.84	35.49
Connecticut	765.4	18.1	783.5	55.19	25.9	861.59	81.09
New England Group	5,290.7	62.6	5,352.3	394.95	125.4	5,873.65	521.35
New York	3,226.54	72.7	3,290.74	154.85	95.3	3,549.39	258.65
New Jersey	1,032.87	25.5	1,058.37	107.66	34	1,200.03	141.66
Pennsylvania	2,471.37	78.25	2,545.62	521.04	64.75	3,135.41	589.79
Delaware	84.75	2	86.75	2.34	3	92.09	5.34
Maryland	484.5	...	484.5	4.5	2	491	6.5
District of Columbia	128	...	128	58	...	186	58
Middle Group	7,428.03	178.45	7,593.98	848.39	199.05	8,653.92	1,059.94

TABLE 6—S. CONTINUED.

UNITED STATES AND CANADIAN WATER-WORKS—MILES OF MAINS BY STATES AND GROUPS OF STATES.

State.	1888 record.	Add.	Extensions Actual. 1888.	Extensions to old works.	Extensions New works.	Total. 1889.	Inc. in 1889.
Virginia	298.05	....	298.05	23.81	25.25	347.11	49.06
West Virginia	96	3	99	11.5	....	110.5	11.5
North Carolina	95.55	0.25	95.8	4.68 [1]	7.5	98.62	2.82
South Carolina	36.35	..	36.35	10.65	....	47	10.65
Georgia	162 75	8	170.75	26.88	8	205.63	34.8
Florida	58.45	....	58.45	13.6	....	72.05	13.6
South Atlantic Group	747 15	11.25	758.4	81.76	40.75	880.91	122.51
Alabama	240.5	....	240.5	32.1	38	310.6	70.1
Mississippi	32.3	0.75	33.05	2.45	21	56.5	23.45
Louisiana	86.5	....	86.5	3.5	..	90	3.5
Tennessee	202.5	....	202.5	24.95	5.5	232.95	30.45
Kentucky	314.25	....	314.25	13.65	12.25	340.15	25.9
So. Central Group	876.05	0.75	876.80	76.65	76.75	1,030.2	153.4
Onio	1,447.46	21	1,468.46	165.21	55.24	1,689.91	221.45
Indiana	528.15	3	531.15	12.88	10	554.03	22.88
Michigan	967.25	14.25	981.5	94.24	98	1,173.74	192.24
Illinois	1,576.07	1.5	1,577.57	89.99	22.5	1,690.06	112.49
Wisconsin	517.82	.....	517.82	36.31	17.85	571.98	54.16
North Central Group	5,036.75	39.75	5,076 5	390.63	203.59	5,679.72	603.22
Iowa	352	1.75	353.75	68.93	17.75	440.43	86.68
Minnesota	345	..	345	39.72	45.65	430.37	85.37
Kansas	311	.....	311	195.32	21.33	527.65	216.65
Nebraska	247	2.5	249.5	49.22	17.45	316.17	66.67
South Dakota	56	3.8	59.8	1.13	9	69.93	10.13
North Dakota	36	.....	36	6 15	2	44.15	8.15
Wyoming	44	... .	44	37	....	81	37
Montana	47	.....	47	1.75	17.75	66.5	19.5
North Western Group	1,438	8.05	1,446.05	399.22	130.93	1,976.2	530.15
Missouri	645	12.5	657.5	44.8	.	702.30	44.8
Arkansas	64	0.5	64.5	15.2	2	81.7	17.2
Texas	465	5.5	470.5	33.63	35	539.13	68.63
Colorado	270	.....	270	69.58	25.3	355.88	85.88
New Mexico	54	2	56	.5	.....	56.5	.5
South Western Group.	1,498	20.5	1,518.5	154.71	62.3	1,735.51	217.01
Washington	66	28	94	34.5	27.1	155.6	61.6
Oregon	115	4	119	6.85	10 5	136.35	17.35
California	1.561	44	1,605	292.88	13.8	1,911 68	306.68
Arizona	19	.....	19	17.5	.....	36.5	17.5
Nevada	127	.....	127	3.7	.....	130.7	3.7
Utah	43	.....	43	4.18	5.5	52.68	9.68
Idaho	11	.....	11	1	3	15	4
Pac. Group	1,942	76	2.018	360.61	59.9	2,438.51	420.51
Total United States	24,257	397.35	24,640.53	2,715.92	898.67	28,268.62	3,628.09
New Brunswick	92.75	..	92.75	3.2	....	95.95	3.2
Nova Scotia	110	..	110	4.5	18.75	133.25	23.25
Prince Edward Island	15.25	..	15.25	..	....	15.25	....
Newfoundland	29	..	29	4	....	25	4
Quebec	308.05	8	316.05	20.95	....	337	20.95
Ontario	583.35	15	598.35	22.26	26.5	647.11	48.76
Manitoba	20	..	20	....	....	20	....
British Columbia	25	17	42	16.5	....	58.5	16.5
Total Canada	1,183.4	40	1,223.4	71.41	45.25	1,332.06	116.69

[1] [The apparent decrease in the mileage of old works in N. C. is due to the fact that two works reported a total of 9 miles less for the 1889-90 than for 1888 MANUAL, and the discrepancy was not discovered in time to write for an explanation.]

New York, Massachusetts and Pennsylvania have the largest mileage, viz.: 3,549.39, 3,336.67 and 3,135.41, or together, more than 10,000 miles, which is over one-third the total mileage in the United States. The smallest mileage is in Idaho Territory, 15, and the smallest in the States is in North Dakota, 44, while South Carolina has but 47 miles of mains.

Considering increase in total mileage we find Pennsylvania, California and New York at the head, with 589.79, 306.68 and 258 miles of increase,

respectively. The smallest increase shown in the United States is in New Mexico, one-half of a mile.

The totals for the various groups will be found in their proper place in Table 6. As would be expected, the Middle States have the greatest mileage, 8,653.92, and the South Atlantic the least, 880.91 miles.

The percentages of increase in total mileage for each group are:

N. E.	Mid.	So. Atl.	So. C.	No. C.
9.73	13.96	16.23	17.46	11.87
N. W.	S. W.	Pac.	U. S.	Canada.
36.65	14.29	20.86	14.72	9.57

New England stands at the foot, as it did in percentage of increase in number of works built in 1889, while the largest increase is in the northwestern group, which ranked third in percentage of increase of new works.

NEW AND PROJECTED WORKS.

Table N includes a summary by groups of States, with totals for the United States and Canada, of the principal available data regarding new works. During the 14 months ending May 1, there were completed, or put under construction, 198 water-works in the United States, and eight in Canada. Of the works in this country six are subsidiary; that is, take their supply from some other plant.

The table shows that of the 198 new works in the United States 77, or 38.9 per cent. were built by municipalities and 121, or 61.1 per cent. by private companies. The record in the MANUAL for 1888, corrected to the close of that year, shows that of 1,762 works in the United States, 742, or 42.1 per cent., were public, and 984, or 55.9 per cent., were private, while the ownership of 36, or 2 per cent., was unknown. The smaller percentage of new public works, as compared with new private, reduces

TABLE N.

NEW WATER-WORKS IN THE UNITED STATES AND CANADA—SUMMARY BY GROUPS OF STATES OF THE PRINCIPAL DATA.

Group.	Popn. on w.-wks., 1880 census.	Number and ownership. Pub.	Priv.	Total.	Cost.	Miles of mains.	No. of hydrants.
N. E.	48,383	8	11	19	$1,027,625	125.4	561
Mid.	189,416	(1) 8	(2) 30	(3) 38	1,785,893	199.05	1,214
So. Atl.	27,202	5	(1) 10	(1) 15	344,500	40.75	235
So. C.	43,869	..	(1) 12	(1) 12	479,000	76.75	574
No. C.	86,246	26	12	38	2,003,837	203.59	1,852
N. W.	53,334	20	(1) 18	(1) 38	1,141,810	130.93	794
S. W.	17,811	4	6	10	399,000	62.3	355
Pac.	30,745	5	17	22	812,500	59.9	230
Total U. S.	497,006	(1) 76	(5) 116	(6) 192	$7,997,165	898.67	5,815
Canada	26,595	5	2	8*	417,000	45.25	341

* Including one of unknown ownership.

the percentage of public works in the United States at the close of 1889 to 41.7 per cent., while the percentage of private works is increased to 57.1, there being 1.9 per cent. of works of unknown ownership. The numbers corresponding to the above percentages are 818 public, 1,106 private, and 36 works of unknown ownership. These figures show a very slight gain in the proportionate number of private works. It is interesting to note in this connection that of the projected works commented on below 108 are reported as public, and 108, the same number, as private enterprises. The remaining 42 projects were not sufficiently advanced to give the proposed

ownership. Of the 8 new Canadian works 5 were built by municipalities, 2 by private companies, while the ownership of one is unknown.

The figures in the last three columns of the table are considerably too small, as in many cases the reports were made before construction was finished there being not even sufficient data to enable one to make reliable estimates.

A comparison of the data for new works with that for works built prior to 1889 is given below. The lines entitled "additions" give data for works included in the supplement to the 1888 MANUAL, and for a few works not reported in time for inclusion in that issue, and is added to the 1888 record in order to give the actual figures for 1888. It should be borne in mind that the sums of the 1888 totals and the figures for new works, in the last three columns would not be the total cost, miles of mains and hydrants for 1889, as they would not include either extensions made to old works or the cost of the same.

United States Water-Works.

	1880. Population.	No. of works.		Cost.	Miles of mains.	No. of hydts.
1888 record	14,857,612	(68)	1,598	$432,225,546	24,257	168,511
Additions	195,731	(3)	93	4,009,361	397	2,218
Total, 1888	15,053,343	(71)	1,691	436,234,907	24,654	170,729
New	497,006	(6)	192	7,997,165	899	5,815

Canadian Water-Works.

1888 record	737,043	(3)	68	21,313,809	1,371	9,314
Additions	14,533		8	376,000	40	126
Total, 1888	751,576	(3)	76	21,689,809	1,411	9,440
New	26,595		8	417,000	45	341

In the MANUAL for 1888 there were included as projected, with fair prospects of construction, 152 water-works in the United States and 7 in Canada. In the 1889–90 MANUAL there are described 258 such projects in the United States and 7 in Canada, a gain of 106 in the United States.

Table P shows the distribution by States and and groups of States of the projected works for both years, and also the estimated population which these works are designed to supply. It will be seen that Delaware, Montana and Nevada are the only States and Arizona and New Mexico the only Territories not reporting new projects, and that six States report but one project each. Pennsylvania and Texas each report 13, and Georgia, Nebraska and South Dakota each report 12 projects. The North Central group has 54 and the Pacific but 25 projects, while the six other groups have each about the same number, the range being from 27 in New England to 32 in both the South Central and North Central groups.

The number of works built in the period covered by this summary exceeded the projected works included in the last MANUAL by 29. Making due allowance for our increased facilities for collecting information regarding new projects and new works, and thus, in part, for the increased number of projects in the 1889–90 MANUAL, it seems safe to say that water-works construction in 1890 will be nearly or quite as active as in 1889, and that there will be at least 175 new works to add to our list by the first of next May. But while the yearly number of new works may remain about the same for a few years the increase in population is not sufficient to

keep up the average population of the towns supplied. This is illustrated by the fact that the average population on the new works reporting the same in the United States, is about 3,600, the average being based on the population of the 1880 census, which is considerably below the actual

TABLE P.

PROJECTED WATER-WORKS IN THE UNITED STATES AND CANADA.

	1889-90 MANUAL. Est. pop.	No.	1888 MANUAL. No.
Maine	5 900	4	12
New Hampshire	20,900	9	3
Vermont	3,000	3	..
Massachusetts	28,500	9	5
Rhode Island	18,500	1	4
Connecticut	4,000	1	3
N. E. Group	80,800	27	27
New York	25,900	10	11
New Jersey	25,150	6	2
Pennsylvania	30,060	13	7
Delaware	.....	..	..
Maryland	3,800	1	3
Middle Group	84,910	30	23
Virginia	2,000	1	8
West Virginia	2,000	1	1
North Carolina	6,800	3	4
South Carolina	9,100	6	3
Georgia	34,200	12	8
Florida	32,800	6	3
So. Atl. Group	86,900	29	27
Alabama	5,300	4	6
Mississippi	7,500	3	3
Louisiana	4,500	2	..
Tennessee	31,300	14	5
Kentucky	34,000	9	5
So. C. Group	82,600	19	32
Ohio	34,500	10	4
Indiana	25,600	6	1
Michigan	18,200	5	3
Illinois	24,000	8	9
Wisconsin	8,800	3	4
No. C. Group	111,100	32	21
Iowa	17,950	11	8
Minnesota	21,500	11	1
Kansas	9,100	5	7
Nebraska	10,500	12	3
South Dakota	7,300	12	3
North Dakota	...	1	
Wyoming	2,300	2	2
Montana	.....	..	..
No. W. Group	68,650	54	24
Missouri	10,000	4	2
Arkansas	14,400	6	2
Texas	26,100	13	8
Colorado	5,200	6	5
New Mexico	.....	..	..
S. W. Group	55,700	29	19
Washington	17,300	11	4
Oregon	6,100	4	2
California	10,900	5	3
Arizona	.....	..	..
Nevada	.....	..	..
Utah	7,000	3	..
Idaho	6,000	2	
Pacific Group	47,300	25	
Total U. S	617,960	258	
New Brunswick	1,800	1	..
Nova Scotia	4,400	1	1
P. E. Island	.....	..	..
Newfoundland	.....	..	..
Quebec	750	1	1
Ontario	5,500	1	2
Manitoba	500	1	..
Northw st Ter	4,000	1	..
British Columbia	12,000	1	..
Total Canada	28,950	7	7

population. The average *estimated* population on projected works reporting the same is but 2,500. Thus it will be seen that there is a difference in the two averages of 1,100, which would certainly be increased to 1,500 and possibly to 2,000 if the estimated populations were taken in each case.

DAMS AND RESERVOIR EMBANKMENTS.

Immediately after the failure, last year, of the South Forks dam, near Johnstown, Pa., we began making a special effort to collect descriptions and illustrations of the water-works dams and reservoirs of the United States and Canada. A large number of responses to our requests were made, and this data, together with that published in the MANUAL for 1888 has enabled us to give in this year's issue full descriptions, often illustrated, of many of the dams and reservoirs of the country and more or less matter regarding hundreds of others. We have thus brought together more information on this branch of engineering, we think it is safe to say, than has ever before been published in one volume. While we have some data regarding nearly every dam or reservoir built for

water supply purposes in the United States and Canada, our descriptions of many are still lacking in some details, owing to the failure of those addressed to forward the information. We therefore take this opportunity to request from engineers and contractors, who have not already done so, full descriptions of dams and reservoirs with which they have been connected in any way, and the same from water-works officials regarding such structures of this class as may form a part of their respective works. Blank forms, convenient for such descriptions, will be sent to any one on application.

Until our data is still more complete it seems best not to make any extensive studies of these structures collectively; but as a matter of general interest we give below a summary, as far as now known, of the height of existing dams and reservoir embankments:

Height.	No.	Height.	No.	Height.	No.
3-10 ft.	112	51-60 ft.	5	115 ft.	1
11-20 "	270	61-70 "	3	119 "	2
21-30 "	119	71-80 "	2		
31-40 "	35	81-90 "	0	Grand total	566
41-50 "	13	91-100"	3		

It should be remembered that this total is somewhat below the total number of dams and reservoirs in the United States and Canada, and described in the MANUAL, as only those are included whose heights are known. Also that the heights given are always, so far as could be ascertained, from the natural surface of the ground to the top of the structure, for dams, and from the foot of the inner slope to the top of the bank for reservoir embankments. The full heights of the latter could not always be ascertained, as often the depth of water in the reservoir was the only dimension given. The above heights would therefore be somewhat increased if fully reported.

The number of these structures above various heights is as follows:

Above	Above	Above	Above
100 ft., 3	70 ft., 8	40 ft., 29	10 ft., 454
90 " 6	60 " 11	30 " 64	3 " 566
80 " 6	50 " 16	20 " 183	

It will be seen that there are very few dams above 40 ft. high; but 183 out of 566, or 32.3 per cent., are above 20 ft. in height, and it may be added that there are 58 dams 20 ft. in height.

There are 14 dams 60 ft. or more in height. Their names and some of their main characteristics are:

Name and Location.	Height in ft.	Extreme length in ft.	Material.	Heart-wall.
Eden Park, Cincinnati, O.	119	1,251	Masonry	.....
Druid Lake, Baltimore, Md	119	Not given	Earth	Puddle.
San Mateo, San Francisco, Cal.	115	400	Concrete	.....
Sweetwater, National City, Cal.	98.5	360	Masonry	.....
Pilarcitos, San Francisco, Cal.	95	640	Earth	None.
San Andreas, San Francisco, Cal.	93	640	Earth	None.
Lake Chabot, Oakland, Cal.	80	300	Earth	Not given.
Boyd's Corners, N. Y. City	78*	670	Masonry and Concrete	.....
Middle Branch " "	73	740	Earth	Rubble masonry
—— Amsterdam, N.Y.	65	410	Earth	Rubble masonry
Bear Valley, Redlands, Cal.	64	300	Masonry	.....
Kauffman, Pottsville, Pa.	61	600	Earth	Not given.
No. 2, Oneonta, N. Y.	60	...	Earth	Masonry.
—— Owego "	60	250	Earth	Masonry.
—— Waverly "	60	322	Earth	Masonry.

* From rock foundation; about 55 ft. from natural surface.

To the above should be added the dam forming Basin No. 4 of the Boston water-works, and that now under construction for Basin No. 5, both

of which are 60 ft. in height, and have been reported to us since the last MANUAL was compiled.

This list includes 10 earth dams, three masonry, one masonry and concrete, or concrete faced with cut masonry, one wholly of concrete. Of the earth dams one has a heart-wall of puddle, five have heart-walls of masonry, two have none, and the material of the remaining two is not given. The two earth dams without heart-walls, respectively 95 and 93 ft. high, have puddle-filled trenches beneath them, carried from the natural surface to solid rock, 26 ft. in the first and 47 ft. in the second instance. The Sweetwater, Bear Valley and Amsterdam dams are of the curved type, in plan.

As would be expected, considerably more than half of the dams and reservoirs under consideration are in the New England and Middle States. The Pacific States have a fair proportion, but the data for this section, and the whole West, is more incomplete than for the rest of the country, and, therefore, exact inferences cannot be deduced.

Among the dams or embankments 20 ft. high or over there are 32 of stone masonry; ten of these are 20 ft. in height; ten, 21 to 30 ft.; nine, 31 to 40 ft.; one each, 64, 98.5 and 119 ft. The last three are described in more detail above, together with a stone and concrete dam 78 ft. high, from the foundation, and a concrete dam 115 ft. high. We also have records of four brick reservoirs, one 21, one 26 and two 30 ft. deep, and of a timber dam at Bangor, Me., 35 ft. high. Among the lesser structures there are several timber dams, and quite a number are built of masonry.

THE FILTERING PLANTS OF AMERICAN WATERWORKS.

In our issue of June 21 we made some general comments upon the mechanical filtration of water, and mentioned, among other things, the comparative slowness with which the filtration of public water supplies has been introduced in this country. The number of filtration plants actually in use, so far as is known, together with their character and their distribution by groups of States, is shown herewith by means of Table F. Of 1,883 main water-works (*i. e.*, having their own source of supply) in the United States, 180 report some mode of filtration in use, and of these 180, seven have duplicate plants, or rather two plants of different character, thus making 187 filtering plants in the United States. In Canada, out of 84 main works, seven employ some method of filtration. Nearly half of the filtering plants in this country are in the New England and Middle States, 46 in each.

The different modes of filtration in vogue are, broadly speaking, three, if we class the mechanical, or *machine*, filters by themselves. The first group aims to employ natural filtration by building underground galleries in saturated soils and letting the water filter into them, either through porous walls or interstices in the walls. In addition, the water thus obtained is sometimes made to pass through filtering material in the bottom of the galleries. All wells filled by surface water partake more or less of the character of filter galleries, but none such are included above. The second mode includes filter beds, basins, chambers, boxes, dykes and dams; in fact, all filtration through artificial layers of filtering material, excepting only that included in the next class.

The third mode is an outgrowth of and improvement upon the first and second, and has resulted from the inefficiency of filter galleries, beds and basins, and the great cost of maintaining the same when on a sufficient

scale to properly filter large quantities of water. It has also resulted from the desirability and need of removing from water matter in solution as well as in suspension, which the old methods of filtration failed to do to any great extent. Still another reason for the recent rapid increase in the use of mechanical filtration is the time required to clean filter beds and galleries, if of any size, and the attendant expense.

It may be well to state here that the terms mechanical filters and mechanical filtration are somewhat ambiguous, as at present used, and therefore there has been coupled with mechanical in the heading to the accompanying table, the word commercial, in order to distinguish more clearly these filters from from the old, stationary ones. The ambiguity in the word mechanical, as used in this connection, lies in the fact that, strictly speaking, mechanical filtration is the removal from water, in this case, of impurities by means of straining the water through some porous material. The material generally used, especially in this country, is sand, gravel or stone, or a combination of these, and such material removes scarcely anything but the matter which is in suspension, and may leave in clear and sparkling water deadly chemical impurities. Such impurities can be removed only after having been precipitated or coagulated, or by the aeration of the water.

It is at just this point that the superiority of the so-called mechanical filter is most evident, for by using a small amount of some coagulant or precipitant these impurities are so acted upon and changed that they may be caught and held by the filtering material as the water passes through. As nearly every filter included in Table F uses some sort of coagulant, and depends largely upon it for its advantage over the old methods, the ambiguity of the word mechanical is evident, and there should be coupled with it coagulating or precipitating. There is, however, one strong reason for the usage, and that is that these filters are specifically machines.

TABLE F.

UNITED STATES AND CANADIAN WATER-WORKS FILTERS.

	Galleries.	Beds and basins.	Hyatt.	National.	American.	Jewell.	Warren.	Olyphant.	Chambers.	Total galleries and beds.	Total mechanical or commercial.	Not given.	Grand total.
New England	17	17	1	3	..	..	1	..	..	34	2	10	46
Middle	5	24	7	2	..	..	..	..	..	29	9	8	46
South Atlantic	0	0	4	1	..	..	..	..	..	0	5	1	6
South Central	1	0	2	1	..	..	..	..	..	1	3	2	6
North Central	8	8	4	3	4	..	..	..	..	16	11	6	33
Northwestern	4	7	5	2	..	1	..	1	..	11	9	6	26
Southwestern	2	4	6	2	1	..	.	..	1	6	10	2	18
Pacific	2	2	1	3	..	..	..	..	..	4	1	1	6
Total United States	39	62	30	11	5	1	1	1	1	101	52	36	187
Canada	0	2	..	1	..	..	..	..	.	2	1	4	7

Leaving the above discussion of terms, we see by examining the table the distribution by groups of States of the various methods of filtration. New England still relies almost wholly upon the old methods, having but two commercial or mechanical filters. The Middle States make a much better showing; the two Southern groups, better still, they having 8 of the newer kind of filters, one of the old, while the mode employed in three cities is not reported. Of 153 filters where the mode in vogue is

known, 52 are of the commercial or mechanical type, and of these 30 are Hyatt, 13 National, 5 American, and one each Jewell, Warren, Olyphant and Chambers.

In Canada, of seven filtering plants the kind of four is not reported. Of the remaining three, two are beds or basins, and one is a National filter.

Of those plants of which the mode in vogue was not given in the reports from which the MANUAL was compiled, sufficient data was furnished to enable us to say that probably all of them are either filter galleries, basins, beds or similar plants, and that most of them are of the nature of small filter beds or chambers.

Considering the material used in filter beds, basins and the like, and in those galleries containing filtering material, we find the following practice:

Number using—		
Sand, gravel or stone, or a combination of these		59
" " " " " "	together with sponge	1
" " " " " "	together with charcoal	17
" " " " " "	together with sponge and charcoal	2
Sponge and charcoal combined		8
Charcoal alone		3
Coke		1
Brick		1
Sponge alone		3
Total		95

The material that can be obtained both the easiest and the cheapest—sand, gravel or stone, or these combined—is used in 59 out of 95 plants, or in nearly two-thirds of the whole, and with sponge or charcoal, or these together, it is used in 79 out of 95, or over four-fifths of all the filters here classified. We find 19 filters using charcoal in connection with sand, gravel and stone, 8 more using it with sponge, and 3 using it alone, and, adding with these the one filter using coke, we have a total of 31 filters using more or less charcoal or coke, or almost exactly one-third of the whole number.

As to the efficiency of charcoal in connection with the filtration of a public water supply, opinions differ. It depends principally on the amount of charcoal used, the provisions for cleaning, the amount of filtration which the water receives before it reaches the charcoal, and the mineral and organic matter contained in the water.

Of 42 other plants, about 20 are galleries, reporting no filtering material within, and therefore probably all relying upon natural filtration, which is generally many times slower than filtration through artificial layers of sand and gravel, and therefore much more complete, and approximating in value to filtration where some precipitant or a large amount of charcoal is used.

In this connection it should be stated that we have records of 19 filter galleries, beds, basins and the like, in the United States, not included in the summaries, that have been abandoned as useless, or practically so. In one or two instances the old filters have been abandoned for a commercial or mechanical filter. A few of the filters included in the summaries are reported as giving very much trouble, generally from clogging, and it is probable that more or less trouble of this sort is experienced with very many of them, largely arising from insufficient provisions for cleaning or from turbid water not first somewhat clarified by settlement. Doubtless more frequent cleansing and renewal of the filtering material would have obviated many of the difficulties encountered, and made abandonment unnecessary; but this has sometimes been deemed impracticable on

account of the expense involved, and perhaps nearly as often neglect has been the cause of failure. Indeed, it is probably true that the majority of the filter beds, and the like, in this country are not cleaned or renewed oftener than once or twice a year, and some of them not at all. All infiltration galleries, or nearly all, cannot be cleaned at all, or at least the material about them cannot be cleansed without removing and replacing quite considerable quantities of sand and gravel, and generally at no small depth.

As there are in the United States 1,883 water-works, of which but 180, or less than one-tenth, report filtering plants, it is evident that there is a large field open to filter manufacturers and hydraulic engineers. For while it is true that many water-works stand in little or no need of filtering plants at present, increasing population, with the increase in the pollution of water supplies which will surely accompany it, will eventually render some mode of purification imperative, or else a rapidly increasing mortality will be the result. And with all that can be said or shown regarding the purity of our water supplies, there are very few that would not in some degree be benefited by filtration. According to table 10-S in the introduction to the MANUAL for 1888, about 40 per cent. of the water-works in the United States, summarized for that issue, took their supplies from running streams. All these supplies need either filtration or subsidence to remove organic matter in suspension, and some need both, while comparatively few have either.

We showed in our issue of June 28, by means of Table 4-S, that 69.4 per cent. of the water-works in the United States and 60.2 per cent. of those in Canada pump either the whole or a part of their supply. A great number, both of pumping and gravity works, are so situated that a head sufficient to pass water through some or any kind of filter can be obtained before the water reaches the pump or goes into the supply main. Whenever this can be done, the wear of the pumps will be saved to a greater or less extent, depending upon the nature and amount of the matter which is removed; the supply mains, reservoirs and distribution system will also be kept clear, and thus the efficiency and economy of the whole system will be increased, as well as a better supply of water secured by filtration.

If such a head as has been mentioned cannot be secured, then in pumping systems the water can be made to pass through one of the mechanical or commercial filters before it enters the force main, the only difference being that the wear of the pumps is not saved. In gravity systems giving ample head in the distributing pipes, a mechanical filter could generally be used somewhere on the supply main, or at least a filter bed, as the latter can be operated under comparatively slight pressure.

Referring again to the introduction to the last, 1888, MANUAL, we find that 6 per cent. of the water-works of the United States have for their supply, surface water; while nearly 26 per cent. take their supply from wells. Surface water, as here used, generally means water collected in reservoirs or ponds, from greater or less surface areas, in distinction from such surface water as is collected in wells. It seems perfectly safe to say that all such water needs purification before being used for domestic purposes, as does much that is taken from surface wells.

We think it is evident to all who have given the matter even casual thought that the purification of the water furnished by the large majority of the cities and villages of the United States and Canada, is an important essential to the health and well-being of those communities, and that the chief method by which this purification can be secured is by filtration

We have seen that, allowing for filtering plants the existence of which is not known to us, only some 10 per cent. of the water-works of the United States and between 8 and 9 per cent. of those in Canada employ filtration. Whatever the number of those without filtration and needing it may be. it is certain that here is a wide and constantly growing field of action for all who are interested in securing for the people of our cities and villages a pure water supply, whatever their motive may be ; and it should be borne in mind that the responsibility of having pure water in any village or city does not rest upon the city officials or the water company alone, but upon each taxpayer, since from the latter come both the vote and the money which are the first essentials in securing either a new water supply or any extensive improvements in an old supply.

As to the mode of filtration which should be adopted in a given case, expert advice alone can determine. But there are some general principles which it may not be out of place to mention here. First, it may be stated that where thorough investigation shows that there needs to be removed from the water only matter in suspension, and that largely of a coarse nature, filtration through sand and gravel may often suffice. Secondly, if the water contains very fine organic matter, some of it in solution, or if it contains gases, or if it tastes, smells or looks dirty, it may perhaps be rendered potable by filtering through charcoal or coke, probably with better results, and certainly more cheaply, if it first passes through sand, thus removing the grosser materials. Either of these methods might be employed to advantage, and with comparatively slight cost, in connection with water-works, furnishing consumers with what is generally, and often rightly, considered very good water when unfiltered.

The third principle is founded on the fact that a great number of our available water supplies are so contaminated as to make impracticable and often utterly impossible their proper purification by either of the above methods, thus necessitating the use of some precipitant, and making advisable the use of one of the mechanical or commercial filters. Indeed, any water-works officials who contemplate the introduction of filtration in any form will make a mistake if they do not examine the merits of the various mechanical filters before coming to a decision, as efficiency and cheapness of operation are the main claims of their manufacturers, and, so far as we can judge, well-merited ones.

An important element in judging of the efficiency of filter beds and basins is the area and depth of the filtering material and the amount of water which must be passed through it per square foot in a given time. Much can also be learned from the recorded failures of filter beds and basins; but lack of space forbids the consideration of either of these subjects in this issue, and, besides, it seems advisable to wait until some further data can be collected, in order that a more intelligent and extended study of these latter questions may be made.

FAMILY AND METER WATER RATES IN THE UNITED STATES AND CANADA.

A comparison of the water rates of cities is one of the most accurate methods which can be employed in judging of the efficiency of the management of their water-works, since the expense of their maintenance is largely met by the revenue derived from consumers. This is more especially true when the works are owned by the municipality within which they are located, for in such cases the aim is generally to

keep the rates as low as possible and still realize enough to maintain and operate the works. Companies, of course, furnish water for profit, and therefore a comparison of their rates with those of public works, and with each other, is often desirable in order to ascertain whether they are furnishing water at reasonable figures, while the comparison of a few or all the rates of one class with a corresponding number of those of another is a valuable aid in determining the relative advantages of public and private ownership.

It is well known that the establishment of a satisfactory or even a just schedule of rates is one of the most difficult tasks which water-works officials have to perform, and that these rates are often a bone of contention between private companies and municipalities.

In view of these facts we take pleasure in presenting, in the MANUAL OF AMERICAN WATER-WORKS for 1889-90, the family and meter water rates of about 800 cites in the United States and Canada, and in presenting herewith some deductions therefrom. These rates were in force in 1889, and are abstracted from printed schedules kindly sent us by the various works. We requested rates from every water-works listed in the MANUAL for 1888, and in every case where our first request brought no reply we sent another, and still others to many works. We have published and summarized all the rates received.

Only family and meter rates have been included, as most of the others could not be readily and intelligibly tabulated within small compass. Besides, the rates selected cover the ground admirably, as private consumers are by far the largest and most important class the country over, and the rates of large consumers are generally best indicated by meter charges.

TABLE 1—R.

FAMILY AND METER WATER RATES OF 800 CITIES IN THE UNITED STATES AND CANADA—AVERAGES BY STATES AND PROVINCES OF RATES FOR VARIOUS FAMILY PURPOSES, AND OF METER RATES, TOGETHER WITH AVERAGE COST OF WATER-WORKS PER FAMILY OF FIVE, AND AVERAGE POPULATION ON THE WORKS UNDER CONSIDERATION.

	Present population.	Family rate.	Pan closet.	Bath tub.	Wash bowl.	Horse and carriage, with use of hose.	Cow.	Hose.	Total for family	Cost of works per family.	Range of meter charges per 1,000 galls., in cents.
Maine.											
All works..	9,400	7.63	4.53	4.19	0.87	5.5	1.53	3.5	25.87	167.3	23¾-9¼
Pub. " ..	23,500	5	1.5	2	0	2	1	2	13.5	119.9	22½-2½
Priv. " ..	8,460	7.8	4.73	4.33	0.93	5.75	1.57	3.5	26.73	181.3	25-16
New Hampshire.											
All works..	6,348	6.64	3.6	3.5	0.7	5.03	1.16	4.2	24.9	107.4	27-18.3
Pub. " ..	12,167	6.7	2.41	3.1	0.8	3.5	0.95	3.5	20.4	106.4	25-10.5
Priv. " ..	4,020	7.07	4.1	3.63	0.66	5.53	1.23	4.43	26.4	123.8	27.7-20.6
Vermont.											
All works..	5,000	6.43	3.9	3.23	0.87	3.27	1.36	3.95	22.4	76	40-13⅓
Pub. " ..	7,250	6.66	3.5	3.08	0.50	2.16	1.16	2.91	19.6	81	40-13⅓
Priv. " ..	3,313	6.25	4.4	3.4	1.3	4.6	1.7	5.2	25.8	62	
Massachusetts.											
All works..	16,810	6.46	4.35	4.25	1.32	5.76	1.51	4.51	27.09	106.34	29.33-17.6
Pub. " ..	23,928	6.07	4.27	4.11	1.34	5.09	1.48	4.37	24.74	107.04	27.39-16.3
Priv. " ..	5,597	7.15	4.46	4.5	1.31	6.9	1.55	5.0	31.16	101.42	35. -22.2
Rhode Island.											
All works .	26,550	7.12	5.16	5.16	2.3	9.43	1.3	6.14	35.36	187.61	33.75-18.0
Pub. " ..	82,500	5.5	5.0	5.0	2.3	9.5	1	5.5	28.85	223.9	30-10.5
Priv. " ..	4,566	8.0	5.2	5.2	2.3	9.4	1.5	6.4	38	193.61	36-26.2

TABLE 1—R. CONTINUED.

AVERAGES BY STATES AND PROVINCES OF FAMILY AND WATER METER RATES.

	Present population.	Family rate.	Pan closet.	Bath tub.	Wash bowl.	Horse and carriage with use of hose.	Cow.	Hose.	Total for family.	Cost of works per family.	Range of meter charges per 1,000 gals. in cents.
Connecticut.											
All works..	13,250	5.8	3.35	3.29	0.25	5.13	1.06	4.14	23.62	92.23	27 -12.64
Pub. " ..	15,500	5.1	2.85	2.5	0.15	3.5	1.05	3.05	18.66	98.82	27.4 -13.6
Priv. " .	11,625	6.05	3.6	3.84	0.30	5.95	1.08	4.62	25.87	87.55	26.36-12.72
New York.											
All works..	31,835	6.9	3.35	3.23	0.87	4.44	1.14	4.92	24.74	150.39	39 -13.29
Pub. " ..	69,914	6.1	2.50	2.63	0.61	3.31	0.86	3.85	19.43	112.33	33.4-12.9
Priv. " ..	6,125	7.53	3.96	3.71	1.15	5.36	1.37	5 81	29.18	164.52	43.6-13.6
New Jersey.											
All works..	24,532	8.11	3.20	3.96	1.04	3.42	1.34	4.72	25.27	110.52	28.99-18.6
Pub. " ..	42,042	8.08	2.71	3.50	0.83	2.60	1.30	4.04	20.31	103.31	29.48-16.51
Priv. " ..	13,316	8.14	3.60	4.33	1.20	4.50	1.37	5.27	28.23	124.73	28.49-20.69
Pennsylvania.											
All works..	25,148	7.46	3.7	3.61	1.1	3.86	0.81	4.36	23.91	89.98	27.72-13.4
Pub. " ..	87,122	6.75	2.71	3.7	0.9	3.62	0.80	4.06	21.45	85.8	19.75-09.03
Priv. " ..	7,155	7.66	3.17	3.51	1.16	3.94	0.81	4.45	24.63	106.3	31.71-16.09
Delaware.											
All works..	16,666	5.33	3	3	1	2.92	1	3.75	20.66	74.7	26-12.50
All public works.											
Maryland.											
All works..	102,750	5.71	2.1	2.27	0.31	2.92	1.3	4.38	20.35	137.4	20.35-01.9
Pub. " ..	400,000	12	0	0	0	3	1	3	19	140.2	6-6
Priv. " ..	3,666	3.62	2.8	3.03	0.41	2.9	1.4	4.83	20.80	38.6	25-23.33
District of Columbia.											
All works..	160,000	5.5	0	0	0	1.5	0.250		7.25	265	3-3
One public work only.											
Virginia.											
All works..	18,983	6.63	3.08	3.21	0.58	4.07	1	4.82	24.25	82.2	22 -14.4
Pub. " ..	21,644	6	3.11	3.28	0.39	3.83	1	4.69	23.44	82.2	21.66-12.23
Priv. " ..	11,000	8.5	3	3	1.16	4.58	1	5.17	26.42	82.1	22.5 -17.5
West Virginia.											
All works..	14,000	6.5	4.5	2.69	0	2.5	1	6.19	23.38	91.6	26.66-13.33
Pub. " ..	16,000	6	4.33	1.92	0	2	1	6.25	21.5	93	15 -10.5
Priv. " ..	8,000	8	5	5	0	4	1	6	29	79	50 -20
North Carolina.											
All works..	10,416	8.08	4.62	3.83	1.5	4.08	1.47	5.07	28.45	68.5	31.67-2.33
All private works.											
South Carolina.											
All works..	60,000	12	4	4	1	12	0	6	39	33.3	60-25
One private work only.											
Georgia.											
All works..	24,213	7.39	3.14	5	1.67	4.25	0.5	6	30.88	47.9	25 -18.33
Pub. " ..	31,250	6.66	3	5	0.33	3.17	0.5	6.66	27	44 5	16.66-12.5
Priv. " ..	14,666	10.58	4.33	5	3	5.33	0.5	5.33	34.75	57.5	50 -30
Florida.											
All works..	11,000	10.2								55.3	35.25-15.33
Pub. " .	25,000	12								23.4	16 -9⅛
Priv. " ..	7,500	9.75	4	5.25	2.5	4.5	1.38	8.5	37.88	81.8	41.66-17.33
Alabama.											
All works..	16,786	12	5	5.29	1.5	5.56	1.56	7.71	38.64	128.7	36.5-25
All private works.											
Mississippi.											
All works..	15,000	10	5	5	2	8	2	11	43	58.3	50-50
One private work only.											
Louisiana.											
All works..	85,333	10.33	5.16	5	1	4.16	1.33	10.5	37.5	53.1	40-20
All private works.											

TABLE 1—R CONTINUED.

AVERAGES BY STATES AND PROVINCES OF FAMILY AND WATER METER RATES.

	Present population.	Family rate.	Pan closet.	Bath tub.	Wash bowl.	Horse and carriage, with use of hose.	Cow.	Hose.	Total for family.	Cost of works per family.	Range of meter charges per 1,000 galls., in cents.
Tennessee.											
All works..	34,500	9.86	4.86	5.71	0.86	5.71	2.29	7.5	36.94	88.5	29–15.2
Pub. " ..	80,000	12	6	8	0	4	2	5	37	131.3	15–7
Priv. " ..	26,917	9.52	5.67	5.33	1	6	2.33	8.08	43.1	64	32.5–17.25
Kentucky.											
All works..	31,911	8.01	4.61	5.17	1.75	3.39	1.28	4.11	31.65	125 9	26.25–16.5
Pub. " ..	21,000	9.62	5.25	5.62	1.25	2.88	1.38	4.25	30.25	99.1	27.5–16.5
Priv. " ..	40,640	6.6	4.1	4.8	2.15	3.8	1.2	4	32.77	136.9	25.–16.5
Ohio.											
All works..	28.592	7.09	2.76	3.06	0.50	2.48	1.11	3.29	20.31	107.1	29.1–15.01
Pub. " ..	9,388	7.03	2.63	3.06	0.54	2.5	1.14	2 65	19.52	106.9	22.47–11.78
Priv. " ..	10,000	7.2	2.97	3.06	0.47	2.4	1.07	4.36	21.63	114.5	37.64–18.02
Indiana.											
All works..	19,456	6.17	3.01	3.36	0.76	3.29	1.21	3.46	21 33	63 69	31.56–8.6
Pub. " ..	14,625	4.85	2.58	2.6	0.71	2.3	0.94	2.25	16.22	38.61	2.3–5.83
Priv. " ..	24,727	7.62	3.55	4.18	0.82	4.39	1.56	4.77	26.9	79.87	35.45–9.8
Michigan.											
All works..	15,931	6.47	2.76	2.4	0.26	2.57	1.09	4.28	20.05	80.6	29.73–14.85
Pub. " ..	18,327	5.54	2.14	2.2	0.24	2.1	0.96	4	19.6	32.29	27.41–14.79
Priv. " ..	8,140	9	3.66	2.94	0.39	3.9	1.44	5.19	26.42	70.36	35.71–15
Illinois.											
All works..	36,681	7.53	2.9	2.98	0.74	2.89	1.17	4 55	22.74	79.86	30.28–13.13
Pub. " ..	50,039	6.51	2.69	2.18	0.52	2.54	0.93	4.24	19 82	78.73	25.78–12.18
Priv. " ..	11,181	8.64	3.27	4	1.15	3.5	1.6	5.15	27.78	89.43	39.17–14.38
Wisconsin.											
All works..	20,444	7.73	3.53	3.48	1.22	3.99	1.2	4.32	25.47	83	36.33–11.21
Pub. " ..	34,714	8.43	2.82	2.57	0.14	2.64	0.71	3.14	20.71	76.7	39.24–12.76
Priv. " ..	11,364	7.3	4	4.05	1.91	4.84	1.52	5.07	28.5	95.3	33.9–12 5
Iowa.											
All works..	11,293	7.08	3.2	3.34	0.13	4.07	1.12	5.23	24.12	79.12	39–16.86
Pub. " ..	5,492	6.04	2.71	2.93	0.0	3.25	0.92	4.77	20.67	45.1	37.3–16.4
Priv. " ..	16,679	3.05	3.66	3.73	0.27	4.77	1.31	5.7	27.31	89.52	40.45–32.31
Minnesota.											
All works..	53,438	7.08	3.38	3.31	1.19	3.19	1.5	3.25	22 89	68.75	31.14–12.46
Pub. " ..	94,250	4.66	2.75	2.38	0.38	2.5	1.38	3.25	17.28	63.84	22–9.31
Priv. " ..	12,625	9.5	4.5	4.25	2	3.88	1.63	3.25	28.5	105.44	43.33–12.5
Kansas											
All works..	9,067	7.96	2.78	3 29	0.9	4.18	1.2	4.89	24.52	76.64	41.47–18.21
Pub. " ..	3,770	7.91	2.68	2.67	0	2.64	1.15	4.6	22.31	93.66	40.83–21 5
Priv. " ..	11,326	7.98	2.82	3.53	0.13	4.68	1.22	5.02	25.38	74.19	41.76–16.86
Nebraska.											
All works..	13,759	7.19	2.81	3.13	0.29	2.63	1.14	4.85	22.16	106.55	31.41–13.61
Pub. " ..	7,031	6.45	2.44	2.78	0.13	2.06	1.03	4 15	19.05	31.62	30.21–13.05
Priv. " ..	35,625	9.63	4	4.25	0.5	4.5	1.5	7.13	32.25	156.36	35–15
South Dakota.											
All works..	5,440	12.4	3.8	3	0.2	4	0.7	5.8	39.7	70.05	52.5–17.5
Pub. " ..	3,733	11.25	2 5	1.83	0.0	2.67	0.67	4.17	23.8	49.77	
Priv. " ..	8,000	14.13	5.75	4.75	0.5	6	0.75	8.25	42.13	84.22	52.5–17 5
North Dakota.											
All works..	4,750	16.5	5	3.5	1.5	5.5	1	1.78	34.86	94.74	50–20
One public and one private work.											
Montana.											
All works .	5,500	15.5	2.5	5.5	1	11.5	2.5	9.75	48 25	90.91	75–60
All private works.											
Missouri.											
All works..	54.179	7.65	3.78	4.15	0.05	4.92	1.71	3.81	26 56	133.39	30–16.46
Pub. " .	450,000	7	5	5	0	8	1.5	2.5	29	148.03	30–10
Priv. " ..	23,731	7.71	3.43	3.25	0.06	4.66	1.67	3.91	26.4	111 67	39.6–17

TABLE 1--R CONTINUED.

AVERAGES BY STATES AND PROVINCES OF FAMILY AND WATER METER RATES.

	Present population.	Family rate.	Pan closet.	Bath tub.	Wash bowl.	Horse and carriage, with use of hose.	Cow.	Hose.	Total for family.	Cost of works per family.	Range of meter charges per 1,000 galls., in cents.
Arkansas.											
All works..	15,333	10.67	4	4.83	0	6.33	2.67	3.17	31.67	49.57	35-15.83
	All private works.										
Texas.											
All works .	12,700	14.79	5.55	6.12	0	8.56	1.17	8.02	44.8	61.44	53.46-27.79
Pub. " ..	25,300	9.54	5	5.32	0.40	5.67	6	5.37	31.9	48.52	37.5-20
Priv. " ..	9,200	16.43	5.73	6.6	0.09	9.59	1.38	8.9	49.41	70.74	56.82-28.5
Colorado.											
All works..	9,273	14 26	4.73	4.19	0	5.45	1.62	6.24	36.36	89.75	51.88-22.5
Pub. " ..	3,513	15.56	4.94	3.64	0	4.73	1.29	5.18	33.36	126.78	80-28.75
Priv. " ..	14,394	13.11	5	4.75	0	6.29	2	7.31	39.79	81.72	42.5-21.46
New Mexico.											
All works..	5,500	24	4	4	1	8	4	17.5	63.5	100	63.5-43.75
	All private works.										
Washington.											
All works..	15,667	19	6	4	0	4	3	1.67	37.67	51.78	21.67-15
Pub. " ..	8,500	21	6	3	0	3	3	0	36	54 71	20-15
Priv. " ..	30,000	15	6	6	0	6	3	5	41	50	25-15
Oregon.											
All works..	6,833	16.67	8.43	6	0	9.43	5.71	8.2	54.94	67.48	44.17-31.94
Pub. " ..	14,733	13	6.67	2	0	8	3.4	4.13	37.2	72.97	38.33-27.22
Priv. " ..	2,883	18.5	9.75	9	0	10.5	6.75	11.25	68.25	53.47	51.67-36.67
California.											
All works..	16,419	19.53	6.04	4.2	0	6.26	2.78	5.68	46.13	289.71	53.28-37.13
Pub. " ..	35,000	12	0	4	0	10	4	4.8	34.8	51.14	45⅛-22⅝
Priv. " ..	15,819	19.76	6.26	4.21	0	6.13	2.74	5.71	46.54	302.67	53.62-37.71
	One public work only.										
Arizona.											
All works..	7,000	24	8.4	0	0	6	3	4.8	46.2	55	70-40
	One private work only.										
Utah.											
All works..	20,000	8	1	1	0	4	1	5.5	20.25	63.25	20-20
	All public works.										
Idaho.											
All works..	2,000	21	0	0	0	4	1.5	6	35.5	33.75	
	All private works.										
New Brunswick.											
All works..	7,000	5	5	3	1	5.5	1	3	23.5	79.3	25-15
	One public work only.										
Nova Scotia.											
All works..	15,000	7.07	4	2.67	1.33	7.25	1.13	3.25	29.9	90.5	
Pub. " ..	17,778	5.5	3.67	1.5	6.5	3	0.5	1.5	16.75	81.98	50 35
Priv. " ..	7,000	10.2	5	5	3	20	3	10	56 2	155	50 35
Prince Edward Island.											
All works..	12,000	6	5	3	1	3	1	2	21	63.75	30-30
	One public work only.										
Quebec.											
All works..	38,275	13.76	3	1.33	0.29	2.08	1.25	2 9	25.36	152.67	31⅛-10⅞
Pub. " ..	48,033	1 .66	2.8	0.8	0	1.7	0.9	1.63	22.45	155.41	30-15
Priv. " ..	9,000	14	4	4	1	4	3	8	37	70.05	35-20
Ontario.											
All works..	16,391	7.85	3.21	2 83	0.57	2.23	1.13	4.7	22.22	102.4	30.55-19.65
Pub. " ..	19,900	7.71	3.01	2.61	0.47	2.13	0.95	4.48	21.12	108.3	32.90-18.07
Priv. " ..	8,371	8.03	3.75	3.42	0.71	2.5	1.58	5.16	25.01	70.4	27.27-21.74
British Columbia.											
All works..	15,000	15.6	3	6	0	6	3	6	*39.6	83.33	60 sp.
	One private work only.										

By referring to the headings of Table 1—R, it will be seen that the rates included are, first, the general family rate or charge for introducing water to the premises for general household purposes. This column is a very significant one, since it is absolutely the lowest price for which water will be furnished, and constitutes the entire rental of a large number of consumers, often people who for many years previously used impure well water because they thought they could not afford to pay even this price for "city water." The other rates are for pan water-closet, bath tub, wash bowl or basin (in addition to the kitchen or first faucet), horse and carriage with use of hose for washing the latter, cow, and hand hose for lawns. Following these is their total, which constitutes the sum which must be paid for all these services. If the various schedules mention any reduction for more than one service, the totals are made up accordingly. The meter rates are in cents per million gallons, highest and lowest rates. Immediately following the total family rental is the average cost of the works in question per family, five being always taken as the size of the family. This last has been given as an important adjunct to the table, since a low cost plant, other things being equal, should furnish water at a low rate. Further comments and the tables show whether this is true.

All we can present in these pages is the results by States of averages of the data for all works, public works and private works, which we have done in Table 1—R, and the results by groups of States, the United States and Canada of averages of populations, total family rates and cost of works per family, for which see Table 2–R.

No further explanation of these tables is needed here, but it may be well to add that the full table of rates in the body of the MANUAL is preceded by an introductory page, setting forth in detail the methods employed in making up the tables.

Table 1—R will be of greatest interest to those who wish to compare State with State, or the rates of a particular city with the average for the State in which it is located. These averages can be much more conveniently used for the latter purpose in their natural position in the MANUAL at the end of the rates for each State, where they will be found.

Turning to Table 2—R, we find the average total family rate charged for water from 748 works in the United States to be $26.88; for 318 public works, $21.55; and for 430 private works, $30.82—that is, the average total family rate of the 430 private works is $9.27, or 43 per cent. greater than that of the 318 public works. Looking at the figures for the various groups, we see that in each one of them the rates for private are greater than those for public works, ranging from $4.70 greater in the New England to $20.64, or 71 per cent., in the Pacific States. Turning to Table 1—R, we see that in every State and territory of the Union, and in every province of Canada, private works show a higher total family rate than public, the differences here being very slight in some cases: Maryland $19 against $20.80, or but $1.80; and very great in others, as in Nova Scotia, $16.75 against $56.20, or a difference of $39.45. It should be stated that in Maryland the averages are for but four works, of which those at Baltimore are the only public; and that in Nova Scotia the averages are for two public and one private works, all in small towns.

Both the lowest and highest single rentals per family are for company works, $3.25 at Pineville, Ky., and $94.20 at San Angelo, Tex. But while such low rates prevail for this one company, the next lowest company

rentals are: $14 in Chillicothe, O., and $14.50 at Wadsworth, O., with but few below $20; while in the city of Washington the total family charge is but $7.25; in Elgin, Ill.. $10; Allegan, Mich.. $10.50; in Minerva, O., $12; and in at least 20 cities and villages having public works below $15.

Our next inquiry is, since the private works charge a uniformly higher rate, is it not true that their plants are more expensive, and that thus a higher price for water is essential? If this be so, then, other things being equal, the advocates of private ownership have lost one of their strongest points. Referring to Table 2—R, we see that in the New England, the

TABLE 2—R.

UNITED STATES AND CANADIAN WATER RATES—AVERAGES BY GROUPS OF STATES AND FOR THE UNITED STATES AND CANADA OF THE POPULATION, TOTAL WATER RENTAL PER FAMILY AND TOTAL COST OF WORKS PER FAMILY, SHOWN FOR ALL WORKS, FOR PUBLIC WORKS AND FOR PRIVATE WORKS.

	Population,		Total rental per family.		Total cost per family.	
NEW ENGLAND.	No.	Av. Pop.	No.	Av. rental.	No.	Av. cost.
Av. of all works....	169	14,055	161	$26.61	168	$116.02
Av. of pub. "	75	22,989	73	23.42	75	118.60
Av. of priv. " ...	94	6,927	88	28.12	93	109.18
MIDDLE.						
Av. of all works....	213	32,095	196	24.12	211	111.78
Av. of pub. " ..	77	76,352	73	19.36	77	110.12
Av. of priv. "	136	7,184	123	26.94	134	121.73
SOUTH ATLANTIC.						
Av. of all works....	35	18,009	33	27.48	35	65 46
Av. of pub. " ...	17	23,106	14	23.79	17	67.87
Av. of priv. " ...	18	13,194	19	30.20	18	61.51
SOUTH CENTRAL.						
Av. of all works....	27	33,970	27	35.91	26	94.85
Av. of pub. "	5	32,800	5	31.6	5	117.83
Av. of priv. "	22	34,236	22	36.88	21	89.84
NORTH CENTRAL.						
Av. of all works....	150	24,717	145	21.55	150	86.71
Av. of pub. "	92	32,132	88	18.73	92	85.89
Av. of priv. "	58	12,955	57	25.92	58	89.89
NORTHWESTERN.						
Av. of all works....	94	13,970	91	24.91	93	79.68
Av. of pub. "	44	13,538	42	20.77	44	58.37
Av. of priv. "	50	14,350	49	28.46	49	97.39
SOUTHWESTERN.						
Av. of all works....	59	21,445	52	37.73	58	107.89
Av. of pub. "	15	40,307	14	32.53	15	126.32
Av. of priv. "	44	14,560	38	39.64	43	91.03
PACIFIC.						
Av. of all works....	46	14,899	43	45.64	46	233 39
Av. of pub. "	9	15,133	9	29.32	9	62.22
Av. of priv. "	37	14,829	34	49.96	37	275.88
UNITED STATES.						
Av. of all works....	793	22,358	748	26.88	787	106.63
Av. of pub. "	334	37,223	318	21.55	334	102.09
Av. of priv. "	459	11,541	430	30.82	453	117.28
CANADA.						
Av. of all works....	38	20,189	32	23.98	38	120.04
Av. of pub. "	27	25,133	23	21.07	27	125.16
Av. of priv. "	11	8,964	9	31.43	11	72.67

two Southern and the Southwestern groups, the average cost per family is less for private than for public works; while in the remaining groups the reverse is true. The averages for the whole United States show a cost of $102.09 for all public, against $117.28 for all private works. These are largely affected by the excessive cost of private over public works in the Pacific group. $213.66. These figures are doubtless considerably exaggerated by the inclusion of the cost of some irrigation works used in

connection with those for city supply. It must also be remembered that the averages of cost in this group are for 9 public against 37 private works, and that for the whole United States the average population for the cities under consideration is 37,223 for public and but 11,541 for private works; while in the Pacific States the figures are 15,133 on public, against 14,829 on private works. In addition, some of the works in the Pacific States have extensive systems of storage reservoirs and long and costly aqueducts, especially San Francisco, which make necessary an unusually high cost per family.

In the Middle States we see a slightly higher cost for private than for public works, but here we have a much smaller average population on the first than on the last, 7,184 against 76,352, while in addition the population on public works is very compact. Both of these factors reduce the per family cost of public works.

As there is so wide a diversity in the Pacific States, we will, for the time, leave them out of our calculations, when we find that for the remaining seven groups the average cost of all works is $101.53; public works, $102.53; private, $98.95. By examining the averages for the various States, Table 1—R, we see that they are about equally divided between higher cost private and higher cost public works.

It will now be helpful to place side by side the differences in rental per family and cost per family, with the percentages of each, as follows:

	Averages of total rate per family.				Averages of total cost per family.			
	Public.	Private.	Dif.	Per cent. of dif.	Public.	Private.	Dif.	Per cent. of dif.
N. E.	$23.42	$28.12	$4.70	20	$118.60	$109.18	— $9.42	— 8
Mid.	19.36	26.94	7.58	39	110.12	121.73	+ 11.61	+ 11
So. Atl.	23.79	30.20	6.41	27	67.87	61.51	— 6.36	— 9
So. C.	31.6	36.88	5.28	17	117.83	89.84	— 27.99	— 42
No. C.	18.73	25.92	7.19	38	85.89	89.89	+ 4.00	+ 5
N. W.	20.77	28.46	7.69	37	58.37	97.37	+ 39.00	+ 68
S. W.	32.53	39.64	7.11	22	126.32	91.03	— 35.29	— 28
Pac.	29.32	49.96	20.64	71	62.22	275.88	+213.66	+343
U. S.	21.55	30.82	9.27	43	102.09	117.28	+ 15.19*	+ 15*
Can.	21.07	31.43	10.36	50	125.16	72.67	— 52.49	— 42

* If we again leave out the Pacific States we have the cost, $102.53 for public, against $98.95 for private, a difference of $3.58, or 3.5 per cent., in favor of the private works of the remaining seven groups.

There are such wide variations in the percentages of cost of works per family, and so many factors causing the same that no very reliable deductions can be drawn from these alone. In fact, they were not included for that purpose, but for comparison with the water rates. We see by making such a comparison that the cost of the works has little to do with the variation in price, and certainly does not constitute the reason why private works charge more than public for water, for we find the private works in New England costing 8 per cent. less than the public, and charging 20 per cent. more for water.

In the next group, the Middle, the private works have cost 11 per cent. more than the public, while the rates are 39 per cent. higher, the relation between these percentages being as 1 to 3.54. The Pacific group, with its enormous excess of 343 per cent. in cost of private works, shows rates but 71 per cent. higher, and whatever effect the cost of irrigation works may have had upon the averages for the private works of this group, it certainly accounts for but a small part of their excessive cost, and in no measure for the disproportion between the difference in rates and cost,

There is but one conclusion. Private works charge as high rates as they can in consistency with business principles. If they have high cost works they generally make good use of the fact by charging high rates; but there is no trace of a fixed relation between the two. The latter is shown by the South Central group, where the private works have cost 42 per cent. less than the public, and the charges are 17 per cent. higher for the former than for the latter; and in contrast we have the Northwestern group, with their private works costing 68 per cent. more than their public and their rates but 37 per cent. higher.

One point not yet mentioned needs attention. Money to pay either a part or the whole of the interest on the bonded indebtedness of public works is often raised by taxation, and it might be urged that this accounts for the lower rates charged by public works. But this is offset by the hydrant rental, which is almost invariably paid to private companies, the money for which is always raised by taxation.

Regarding the rates charged for the various fixtures little need be said. The general practice seems to be to charge for the first faucet, the so-called family rate, from one-fourth to one-third of the total charges for the seven purposes included in the table. There is more reason for this than at first seems evident, since by far the greatest amount of water is drawn from the first or kitchen faucet, and where a family has but one faucet all, or nearly all, the water they use is taken from it.

A great many works make no additional charge for one extra set wash basin, but most charge for the third basin, and it is often the case that where no extra charge is made for the second basin the charge for the first fixture is high enough to make up for it. There is one pernicious feature in nearly all the schedules. A lower rate is charged for pan than for other forms of closets. These closets undoubtedly use less water than some of the other styles, but to put a premium, as it were, on their use is a mistake, since the best plumbing practice excludes them altogether. Besides there are other forms which use little or no more water. If a discrimination is necessary the pan closets should not be allowed at all.

In considering meter rates we find a very wide range in prices. In nearly every State the private works charge higher meter rates than do the public. About two-thirds of the works under consideration give meter prices on their schedules, and most of these have a sliding scale. As we stated in the first part of this article, the average meter rates are given for each State in Table 1—R. The averages for groups of States, the United States and Canada are as follows:

Range of Meter Rates.

N. E.	30.14-14.85	N. W.	45.79-22.66
Mid	23.45-12.53	S. W.	54.3 -25.26
So. Atl.	33.45-14.62	Pac.	40.48-24.81
So. C.	36.35-25.34	U. S.	36.71-19.05
No. C	30.92-12.57	Canada	44.62-20.18

The above figures differ from all previously given, in that they are not the averages of all the meter rates in the States included, but are obtained by dividing the sums of the averages of each State by the number of States or Provinces. The results, however, are approximately the same by either method. The lowest meter rates are in the Middle States, the range being from 23.45 to 12.53 cents per thousand gallons. The highest are in the Southwestern group, 54.3 to 25.26 cents.

In concluding we wish to note that the evidence borne by the schedules

of rates which we have received shows an urgent need for reform in the methods used in establishing rates. At present there is the utmost diversity in the charges. Many schedules are copied from others. Some have not been revised for ten or a dozen years. In making up rates for new works the cost of the plant and its future operating expenses are often not taken into account, but the practice in some other city or cities is taken as a guide, or, as has been said, rates are copied verbatim.

Now and then a city has taken pains to ascertain as nearly as possible the actual cost of water for various uses. This should be done for every works. Where meters are not used this is impossible. But the introduction of meters is very desirable, and certainly any village or city will be repaid if it purchases enough meters to experiment on these lines.

If an abundant supply of water for immediate use is at hand few seem to care how much is used, and this being the case, enough money to meet expenses is often raised in what is thought to be the easiest way; or in case of a company the main effort is to secure as large revenues as possible. In either case the highest relative rates will generally be collected along the line of least resistance.

We sincerely hope that the rates presented in the MANUAL OF AMERICAN WATER-WORKS for 1890 will aid in bringing about the reforms so much needed in this connection.

SEWERAGE SYSTEMS.

Good sanitary engineering demands that a city or village having water-works should also have a sewerage system. Those who have considered the matter know that but few cities introduce these public works at the same time and that many towns now sewered had water-works for years before their sewers were built, and that in hundreds of villages and cities a general supply of water has been introduced, while not a mile of public sewers has been constructed.

No general data have been published heretofore regarding the number and character of the sewerage systems in this country: therefore it will not be out of place to include here some information regarding this important branch of engineering.

The data presented herewith has been very kindly furnished us by the water-works officials of the country, and will be found in detail in connection with the descriptions of the various works in the body of the MANUAL. As there cannot be sewerage systems where there are no water-works, we have confined our inquiries to the towns having the latter, requesting from each a statement as to whether they had a sewerage system.

Of 1,960 water-works in the United States, 1,366 have replied to our inquiries, and their answers are summarized for groups of States and the United States in Table S, as are also the replies for Canada. The 594 works in the United States and the 22 in Canada for which we have no data are mostly in small towns, over a third of which have had water-works only since 1889, and very few of which have sewerage.

Of the 1,366 works included in the table, 466 report sewers, 84 report that the town is partially sewered, 25 that a sewerage system had been projected, and 816 that the town is entirely without sewers.

The total number of towns in the United States for which either a sewerage or partial sewerage system was reported is 550. We doubt if

anywhere near 10 per cent. of those towns for which no report was given have sewerage, but even if there were 50 such we would have but 600 sewerage systems against 1,960 water works.

TABLE S.

SEWERAGE SYSTEMS IN THE UNITED STATES AND CANADA—BY STATES AND GROUPS OF STATES.

Group	Sewered.	Partially sewered.	Without sewers.	No. reporting.	Total No. of water-works.	Sewers projected.
New England.....	85	14	132	231	325	4
Middle.....	117	24	184	325	509	2
South Atlantic.....	16	2	39	57	92	3
South Central.....	19	2	23	44	71	0
North Central.....	106	25	153	284	377	9
Northwestern.....	58	9	138	205	268	3
Southwestern.....	28	4	83	115	152	2
Pacific.....	37	4	64	105	166	2
United States.....	466	84	816	1,366	1,960	25
Canada.....	26	8	31	65	87	1

Canada makes a much better showing, with 26 towns sewered and eight partially sewered, or 34 out of 87 having water-works. But Canada has been backward in the introduction of water-works, and as those built are in the larger cities we would naturally expect to find that a greater proportion are sewered.

It will be seen that the Middle and North Central groups show a large number of towns partially sewered. Doubtless many other towns, both in these and the other groups, would properly come under this head, but we have summarized them as reported.

Of course, many of the villages and cities which are now without sewers are small and not compactly built, but it is often true that such places have an unlimited supply of water, or at least use large quantities, and in any case the continual use of cess-pools cannot fail to be a menace to health. But the towns without sewerage are not all small, there being 61 in the United States with an estimated population of 10,000 or over. Of this number 33 have a population of from 10,000 to 15,000; 10 of 15,000 to 20,000; 7 of from 20,000 to 25,000; and 11 have a population of 25,000 or over.

The names and populations of the latter, ranged according to size, are as follows:

Dayton, O.....	55,000	New Albany, Ind.....	30,000
San Antonio, Tex.....	45,000	Austin, Tex.....	27,000
Mobile, Ala.....	40,000	Auburn, N. Y.....	26,000
Knoxville, Tenn.....	40,000	Lexington, Ky.....	26 000
Galveston, Tex.....	40,000	Joliet, Ill.....	25,000
Houston, Tex.....	31,000		

It is probable that some of these might have been included under the head of partially sewered, but none were so reported. Austin, Tex., it is said, has two miles of private sewers.

Of these 61 towns 48 have had water-works since 1885, 22 since 1875, 7 since 1860, 5 since 1850, and 1 since 1799. For all these years cess-pools and open drains have been used, and the soil has been filling with impurities. In view of this, it is indeed a wonder that a pestilence does not break out in many an American city. The death rate in nearly all our cities is far larger than it need be, but who can tell how much it might be reduced in the unsewered cities, and to what enormous height it may arise in any particularly unhealthy summer?

It is probable that nearly all of these 61 cities, and many of the smaller ones without sewers, as well, could raise the money necessary to put in a

system if the general apathy regarding the subject could be overcome. True, municipal expenses are increasing at a rapid rate all over the land, but sound financiering and judicious management of public works would make possible many improvements now thought to be beyond reach.

All but four of these 61 cities have their streets lighted by electricity, and nearly all were lighted by gas when the electric lights were introduced. The entirely new capital required for electric lighting upon which interest has to be paid would have gone a long way towards establishing sewers, at least in the most densely populated sections.

All but 19 of these cities have no water-debt, as their works are owned by companies; so heavy interest on water bonds cannot be one of the excuses for not putting in sewers. What, then, is the reason? Of course we can only conjecture, but it seems probable that in most cases the people do not yet realize their present unsanitary condition, and besides, the taxpayers are doubtless against expenditures for the construction of sewers. In addition, some towns have already reached, or nearly reached, the limit of their bonded indebtedness, and they need many public improvements besides sewerage. Another drawback is that special legislation is required in some States before a city can issue bonds for any purpose.

Most American villages and cities of importance are already supplied with water, but we have seen that large numbers are yet entirely without sewerage, while many of those reporting sewers have hardly taken the first step toward providing an adequate system. Here, then, is a wide field for our engineers, but one requiring hard and often unappreciated labor to develop.

NOTICE.

Water-Works Officials

will greatly oblige us by mailing to us their latest **Annual Reports** and **Schedules of Water Rates,** and by giving notice of any errors or omissions they may find in the description of their works.

Hydraulic Engineers and Contractors

will likewise favor us by noting errors or omissions, and by informing us of new water-works with which they are connected, or of which they have knowledge.

The Manual

OF

American Water-Works.

1889-90.

GROUP I.—New England States.—Water-Works Completed, in Process of Construction or Projected, in Maine, New Hampshire, Vermont, Massachusetts, Rhode Island and Connecticut.

MAINE.

Water-Works Completed or in Process of Construction.

AUBURN, *Androscoggin Co.* (Pop., 9,555; est., 10,000.) On west bank of Androscoggin river, on land rising 55 ft. between river and range of hills ½ mile distant. Settled in 1786, incorp. a city in '69. Has sewers and electric lights.

History.—Built in '69 by Auburn Aqueduct Co. Des. Engr., J. Herbert Shedd, Providence, R. I. Const. Engr. and Supt., F. M. Jordan, Auburn.

Water Supply.—Lake Auburn, by gravity, with pumping for fire protection. Lake is 118 ft. above, and 3 miles north of city. Area, 5 sq. m., beyond which it has a limited drainage basin. Lake has nearly level, sandy bottom, with general depth of 30 to 35 ft., and several deep holes, one being 300 ft. in diam. and 119 ft. deep.

Conduit.—C. i., 12-in. for first 3,000 ft., 10-ins. for remaining 2½ miles. Dy. cap., 1,500,000 galls.: av. head, 118 ft.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two Worthington. *Boilers:* One upright, one horizontal.

Tank.—Cap., 500,000 galls.; plate-iron, 60 x 18 ft.; from Cunningham Iron Works, Boston, Mass. On Goff's hill, 4,000 ft. from river, 230 ft. above city. Water lifted 173 ft. and taken from conduit, 63 ft. below level of pond, at point where size of pipe is diminished.

Distribution.—*Mains*, 12 to 6-in. c. i., 25 miles. *Services*, galv. i. *Taps*, 1,100. *Meters*, 12. *Hydrants*, Whittier, Chapman, 60.

Consumption, 500,000 galls. *Pressure:* ordinary, 52 lbs.; fire, 100 lbs.

Financial.—Cost, $250,000. Debt, $40,000. Int., 4%. Ann. op. exp., $4,000. Ann. rev.: consumers, $18,500; city, $2,300, Hydrant rental, exemption from taxation.

Management.—Prest. and Supt., F. M. Jordan. Secy. and Treas., N. J. Jordan.

AUGUSTA, *Kennebec Co.* (Pop., 8,665; est., 11,000.) On Kennebec river, at head of tidal navigation, on ground rising from river to a considerable elevation. A dam in river furnishes valuable water-power. Incorp. city. Partially sewered. Has electric lights.

History.—Built by a Co. in '73, extended or rebuilt by Augusta Water Co. in '86. Des. Engr., J. Herbert Shedd, Providence, R. I. Const. Engr., E. B. Cummings, Portland. Contrs., Westcott & Manly.

Water Supply.—Kennebec river, pumping to reservoir. Original supply, by gravity from 3,000,000 gall. impounding reservoir on small stream.

Reservoir.—Cap., 6,000,000 galls.; earth, 329 ft. above river.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; from R. D. Wood & Co., Philadelphia, Pa.

Distribution.—*Mains*, 12 to 6-in. c. i., 22 miles. *Services*, ¾-in. galv. i. *Taps*, 800. *Meters*, none. *Hydrants*, Chapman, 92. *Valves*, Chapman and Eddy.

Consumption, 1,000,000 galls. *Pressure*. 125 lbs.

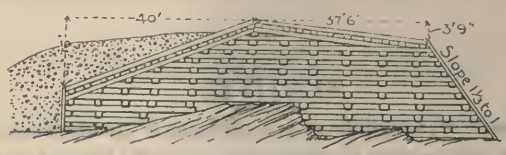
Financial.—Cost withheld, est., $275,000. Cap. stock (in '88), $25,000. Bonded debt (in '88), $100,000. Ann. op. exp., withheld, est., $6,000. Ann. rev.: consumers, withheld, but est. $25,000; city, $2,760. Hydrant rental, $30.

Management.—Prest., Geo. P. Westcott, Portland. Treas., J. H. Manly. Supt., W. H. Williams.

BANGOR, *Penobscot Co.* (Pop. 16,856; est., 19,000.) On west bank of Penobscot river, at its junction with the Kenduskeag, about 55 miles from ocean. Above city both rivers are broken by falls, affording good water-power. The topography is very irregular. Has large lumber industries and builds ships. Incorp. a town in 1791; city in '34. Has sewers and electric lights.

History.—Built in '75-'6 by city, when pop. was 12,000. Asst. Des. Engr., Galen W. Pearsons, Kansas City, Mo. Const. Engr., F. H. Eaton. long time Engr. of the works. Contrs., Holly Manufacturing Co., Lockport, N. Y. Supplies water to Brewer, across the river.

Water Supply.—Penobscot river, direct pumping, there being an impounding dam and a filter gallery. Drainage area of 7,200 sq. m., mostly covered by forest. Mean annual rainfall, about 42 ins.



Timber Dam across Penobscot River, Bangor, Me.

Dam.—At Treat's Falls, where there are rapids falling 22 ins. Tide has mean rise and fall of 12 ft. River bottom is of slate ledge. Irregular, with trench at angle of 45° with flow of stream. Dam has overflow of 900 ft., its crest is 8 ft. above mean high tide; from 55 to 85 broad at base, 12 and 35 ft. high. Has sluice for rafts and logs, 33 ft. wide by 317 ft. long. Dam is of crib-work, filled with stone, lower part being built up with timber to a level at top of irregularities in river bottom. Crib bolted with ⅞-in. iron bolts and solidly backed with stone, then covered with 6-in. hemlock plank. Toe of dam filled and covered to depth of from 8 to 10 ft. with gravel and stone. Has granite abutments 10½ ft. higher than crest of dam, and wing walls. See accompanying section. Cost, $150,000.

Flumes.—*Old:* Not described. *New:* heading to filters; 16 ft. wide, 55 ft. long, 10 ft. high; pine, supported on steel beams. Two 7-ft. w. i. draft tubes reach into water beneath flume.

Filter Galleries.—Two, side by side, each 12½ x 153 ft., with stone sides and arched tops. Filtering material, 3 ft. of sand and gravel, through which water passes downwards to a brick drain connecting with the pump-well. In coming to the filters, water passes from the wheel-pit through revolving wire-cloth screen to wooden troughs extending over whole length of galleries. Screen is octagonal, 12 ft. long, with 35 meshes to inch. Revolves once in 10 minutes, and thus is self-cleansing. It is attached to the pump shaft. Water over filtering material is about 4 ft. deep. Filters cleaned annually of about ¼ in. of sediment.

New Suction Pipe.—Is 24 ins. in diam., and connects both pumps with filters.

Pumping Machinery.—Dy. cap., 9,000,000 galls.; 4,000,000 Holly, 5,000,000 Gaskill water-power. Holly pump was the first to be put in, and for one year was run by a Holly engine having two 21x30 low-, and two 14x24-in. high-pressure cylinders. The pump has four 12x27 in. plungers, and since the first year it has been run by water-wheels, engine being held for reserve. Holly elliptical rotary pump was put in as a supplementary soon after the works were built; cap., 16 galls. per revolution. New Gaskill, not described. *Water wheels:* Now 5 turbines, all made by Stout, Mills & Temple, Dayton, O. First were three 84-in. wheels, 125 H. P. each, at 8-ft. head, and using 110 galls. per revolution. Two of these were run at a time. The two new 66-in. wheels were recently added, and are "New American Turbine,

each of 125 H. P. at 8 ft. head. New wheels connect directly with pumps by means of 7-in. shafting. Head varies with tide, being from 5 to 11 ft. *Boilers:* Horizontal, 5x15 ft., with 56 2-in. tubes. Used only in emergencies. For further details of old pumps see MANUAL for 1888.

Force Main.—C. i., 16 ins. in diam., 5,316 ft. long.

Distribution.—*Mains*, 16 to 4-in., c. i., 29¼ miles. *Services*, galv. i. *Taps*, 2,610 *Meters*, none. *Hydrants*, Holly, 172. *Valves*, Eddy, Ludlow, Chapman.

Consumption, 1,843,000 gals. *Pressure*: Ordinary, 110 lbs. Fire, 110 lbs.

Financial.—Cost, about $550,000. Bonded debt, $500,000. Int., 6%. Ann. op. exp., $6,500. Ann. rev.: consumers, $27,000; city, $9,568. Hydrant rental, $40. Original cost, about $200,000. Cost in '80, $487,022.

Management.—Water Board, of which the Mayor is Chairman. Supt., Frank E. Sparks. Clerk, G. W. Snow.

NOTE.—For a more detailed description see *Eng. News*, Vol. IV., pp. 59, 60; also Tenth Census U. S., Vol. XVII., Water Supply, p. 122.

BAR HARBOR, *Hancock Co.* (Pop., 624; est., winter, 1,800; summer, 4,000.) A summer resort on Frenchman's Bay. Has sewers. No electric lights.

History.—Built in '74 by Bar Harbor Water Co.

Water Supply.—Eagle Lake, by gravity. Lake 2 miles long, ¾ mile wide, 275 ft. above sea.

Intake Pipe.—Extends 200 ft. into lake.

Distribution.—(For '87) *Mains*, c. i., 15 miles. *Services*, w. i. *Taps*, 400. *Meters*, none. *Hydrants*, Mathews, 30. *Valves*, Eddy, Chapman.

Consumption, not known. *Pressure*: Ordinary low levels, 90 lbs., Fire, do. 90.

Financial.—(For '87) Cost $150,000. Cap. stock, $50,000. No debt. Hydrant rental free. No other financial data given.

Management.—Supt., Stephen L. Kingsley.

NOTE.—No reply to inquiries sent in '89.

BATH, *Sagadahoc Co.* (Pop. 7,874; est., 8,000.) On Kennebec river, 12 miles from its mouth. Has superior advantages for navigation. No sewers. Has electric lights.

History.—Built in '86-7 by National Water Works Syndicate, Boston, Mass., under a 30-years' franchise. Sold in July, '88, to H. M. Payson & Co., Bankers, Portland. Des. Engr., J. Herbert Shedd, Providence, R. I. Const. Engr., E. H. Gowing, Boston, Mass. Contr.,—Durfy, Providence, R. I.

Water Supply.—Thompson's brook, pumping to stand-pipe.

Dam.—On brook, earth, 7 or 8 ft. high, 20 ft. long.

Filter.—Gravel and sand.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two 1,500,000 Worthington comp.

Stand-Pipe —Cap., 600,000 galls.; from New England Ship Building Co.

Distribution.—*Mains*, 12 to 4-in. c. i., 22 miles. *Services*, galv. i. Pipe and specials from R. D. Wood & Co., Philadelphia, Pa. *Taps*, 800. *Meters*, Worthington, 9. *Hydrants*, Ludlow, 120. *Valves*, Ludlow, 60.

Consumption, 300,000 galls. *Pressure:* Ordinary, 80 lbs.

Financial.—Cost, est., $300 000. Cap. stock, $500,000. Bonded debt, $256,000. Int., 5 and 6%. Ann. op. exp., not given, est., $6,000. Ann. rev.: consumers, $10,400; city, $4,600. Hydrant rental, $40 for 100, $30 for additional.

Management.—Prest., C. H. Payson. Secy. and Treas., E. R. Payson. Both of Portland. Supt., W. Wakefield.

BELFAST, *Waldo Co.* (Pop., 5,308; est., 6,000.) At head of Penobscot Bay; has fine harbor. Engaged in shipbuilding, manufacturing, and domestic commerce. Incorp. a city. Sewerage system designed by Wheeler & Parks, in '89. Has electric lights.

History.—Built in '87 by Belfast Water Co., under perpetual franchise; put in operation Jan. 1, '88. Engrs. and Contrs., Wheeler & Parks, Boston, Mass.

Water Supply.—Little river, by pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 1,750,000 galls.; Deane; 1,000,000 water-power, and 750,000 steam compound. *Water-wheel:* Hercules turbine. *Boilers:* from E. Hodge & Co., East Boston, Mass.

Tank.—Cap., 238,000 galls.; 30 x 45 ft. From E. Hodge & Co., East Boston Mass.

Distribution.—*Mains*, 10 to 4-in. c. i, 8 miles. *Services*, ¾-in. enam. i. Pipe from R. D. Wood & Co., Philadelphia; specials from, do., and Builders' Iron Foundry, Providence, R. I.; trenching and pipe-laying done by Ferris & Halladay, Jersey City, N. J. *Taps*, 250. *Meters*, Crown, 5. *Hydrants*, Coffin, 50. *Valves*, Coffin.

Consumption, not given. *Pressure:* Av., 80 lbs.

Financial.—Cost, $165,000. Cap. stock, $100,000: $80,000 common, $20,000 preferred. Bonded debt, $65,000. Int., 5%. Ann. op. exp., $2,750. Int. on bonds, $3,250. Ann. rev.: consumers, $4,500; city, $1,800. Hydrant rental, $36; 20-years' contract.

Management.—Prest., Chas. F. Parks, Waltham, Mass. Treas., Elbert Wheeler, Boston, Mass. Clerk, Chas. Baker. Supt., D. N. Bird.

BIDDEFORD and SACO, *York Co.* (Pop.: Biddeford, 12,651; est., 12,651. Saco, 6,389; est., 6,400. On opposite sides of Saco river, 6 miles from its mouth. Both villages engaged in manufacturing; incorp. Biddeford has sewers and electric lights.

History.—Built in '84-5 by the Biddeford & Saco Water Co. Engr., E. B. Cummings, Portland.

Prior to building of present works, Saco Water Power Co. operated a plant, pumping from Saco river to reservoir. There was a granite dam at river, costing $20,000. Pumps were Fales & Jenks rotaries and W. P. Crocker's twin rotary, all run by water-power. The 252,000 gal. reservoir was of granite, lined with brick and cement, roofed, and was 85 ft. above pumps. Main conduit was of 12-in. c. i. Distributing mains were 12, 8 and 6 ins. in diameter.

Water-Supply.—Saco river, pumping to reservoir.

Filter.—Sand and gravel.

Reservoir.—Cap., 10,000,000 gals.; stone; 200 ft. above Saco river at tide level.

Pumping Machinery.—Dy. cap, 7,500,000 galls.; 3,000,000 Deane comp., cond.; 4,500,000 Worthington.

Distribution.—*Mains*, 12 to 4-in.. c. i., 24 miles. *Services*, galv. i. *Taps*, 1,365. *Meters*, Crown, 6. *Hydrants*, Mathews, 114. *Valves*, Eddy. *Pressure-recording gauge*, Edson.

Consumption, 1,100,000 galls. *Pressure*: Ordinary and fire, 60 lbs.

Financial.—Cost, withheld, est., $350,000. Capital stock and bonds, withheld. Int., 5%. Ann. op. exp., withheld, est., $10,000. Ann. rev.: consumers, withheld, est., $40,000; city, $5,700. Hydrant rental, $50 each for 10 years, afterward free.

Management.—Prest., D. H. Clark. Secy. and Treas., Geo. P. Westcott, Portland. Supt., Jas. Burnie.

BOOTH BAY HARBOR, *Lincoln Co.* (Pop., 1,000; est., 3,500.) On Atlantic coast. Engaged in fishing and ice trade. Incorp. a town. Has sewers. No electric lights.

History.—Built in '89 by Booth Bay Water Co., under 25-years' franchise; put in operation about Dec. 1. Engr. and Contr., Jesse W. Starr, Jr., Philadelphia, Pa.

Water Supply.—Lewes' pond, direct pumping and pumping to stand-pipe.

Reservoir.—Cap., 3,500,000 galls.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; two 750,000 Barr comp., dup., cond.

Stand-Pipe.—Cap., 264,000 galls.; 30 x 50 ft.; from Porter Mfg. Co., Syracuse, N. Y.

Distribution.—*Mains*, c. i., 5½ miles. *Hydrants*, 25. *Valves*, Peet.

Financial.—Cost, $65,000. Cap. stock, $50,000. Bonded debt, $50,000. Int., 6%. Hydrant rental, $80.

Management.—Prest., Jos. R. Nickerson. Secy. and Treas., Chas. H. Fisher. Supt., A. Kenniston.

NOTE.—Not finished at time of report.

BREWER, *Penobscot Co.* (Pop., 3,170; est., 3,207.) On Penobscot river, opposite Bangor. Incorp. Partially sewered. Has electric lights.

History.—Built in '83 by Brewer Water Co.

Water Supply.—Bangor Water-Works, direct pumping through main on bridge over Penobscot river.

Distribution.—*Mains*, c. i., 6¼ miles; over 3 miles of 8 and 6-in. pipe added in '89. *Taps*, 400. *Meters*, none. *Hydrants*, Holly, 21, and 10 set summer of '89.

Consumption, not given. *Pressure:* Ordinary, 100 lbs. Fire, 130 lbs.

Financial.—Cost, $40,000; cap. stock, $50,000. Bonded debt, $40,000. Bonds, authorized, $75,000. Int., 5%. Ann. op. exp., not given, est., $1,000. Ann. rev.: consumers, $3,000; city, to be $1,000. Hydrant rental, $40.

Management.—Prest., F. M. Laughton. Treas., F. H. Clergue. Secy., F. A. Floyd. Supt., H. T. Sparks.

BUCKSPORT, *Hancock Co.* (Pop., 3,047; est., 3,500.) Is 18 miles from Bangor. Engaged in ship-building, fishing, farming and tanning. No sewers. Has electric lights.

History.—Built in '89 by Bucksport Water Co. Co. chartered in '87, organized Feb., '88; work begun Aug. 26, '89, put in operation near close of '89. Contr., Jas. Mitchell, Bucksport.

Water Supply.—Great pond, 1 mile from village, by gravity. Pumping may be adopted later.

Distribution.—*Mains*, 8 and 6-in., material not given, 3 miles.

Pressure: 40 lbs.

Financial.—Cost, about $20,000. Cap. stock, $20,000. Bonds, none.

NOTE.—Latest official report, Sept. 23, '89.

BRUNSWICK, *Cumberland Co.* (Pop., 5,384; est., 6,000.) On Androscoggin river. Engaged in lumber trade and manufacturing. No sewers. Has electric lights.

History.—Built in '86-7 by Pejepscot Water Co. Engr., E. B. Cummings. Contr., Eph. Dyer, Portland.

Water Supply.—Androscoggin river, pumping to stand-pipe; also springs collected in reservoir.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; two Deane comp., dup.: 1,000,000 cond., and 500,000. *Boilers:* two 50 H. P., steel, tubular.

Stand-Pipe.—Cap., 625,000 galls.; 40 x 70 ft.

Reservoir.—Cap., 7,000,000 galls.; impounding.

Filter.—Warren system.

Distribution.—*Mains*, 12 to 4-in. c. i., 10 miles. *Services*, galv. i. *Taps*, 262. *Meters*, 2. *Hydrants*, Mathews, 62.

Consumption, 200,000 galls. *Pressure:* Ordinary, 60 lbs.

Financial.—Cost, $120,000. Bonded debt, $100,000. Int., 5%. Ann. op. exp., withheld, est., $4,000. Ann. rev.: consumers, $6,000; city, $2,000. Hydrant rental, $33.33 each.

Management.—Prest., Stephen J. Young. Secy., Geo. F. West. Treas., Geo. P. Westcott, Portland, Me. Supt., I. H. Simpson.

CALAIS, *Washington Co.* (Pop., 6,173; est., 6,000.) At head of navigation on St. Croix river. Engaged in shipbuilding and lumber trade. No sewers. Has electric lights.

History.—Built in '86 by Calais Water Co. Extension of system supplies St. Stephen and Milltown, N. B. Engr., M. M. Tidd, Boston, Mass. Asst. Engr., H. C. Todd, Calais. Contr., Jas. J. Newman, Providence, R. I.

Water Supply.—St. Croix river, by gravity from filter crib in river to suction well, thence by pumping to reservoir.

Filter.—Sand and gravel, in crib in river.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; Blake: 2,000,000 dup., comp., cond., 1,000,000 high-pressure.

Reservoir.—Cap., 2,500,000 galls. On Todd's mountain, Milltown, N. B., 1½ miles from pump-house, and 125 ft. above high water in St. Croix river, in Calais.

Distribution.—*Mains*, 12 to 6-in. c. i., 16 miles. *Services*, tarred i. *Taps*, 400. *Meters*, Crown, 10. *Hydrants*, Chapman, 65. *Gates*, Chapman.

Consumption, 160,000 galls. *Pressure:* Ordinary and fire, 80 lbs.

Financial.—Cost, withheld, est., $170,000. Cap. stock, $200,000. Bonds, $120,000. Int., 5%. Ann. op. exp., withheld, est., $5,000. Ann. rev.: consumers, withheld, est., $24 000; city, $3,260. Hydrant rental, $50.

Management.—Prest., Weston Lewis. Secy. and Treas., Josiah S. Maxey, both of Gardiner. Supt., Willis E. McAllister.

CAMDEN, *Knox Co.* See Rockland.

CARIBOU, *Aroostook Co.* (Pop., 2,756; est., 4,300.) On Aroostook river. Engaged in manufacturing and general trade. Settled in '43; incorp. a town. Has electric lights.

History.—Built in '89 by Caribou Water Co., under 20-years' franchise; put in operation Oct. 15, '89. Des. Engr., M. M. Tidd, Boston, Mass. Const. Engr., Freeland Jones, Caribou.

Water Supply.—Aroostook river, pumping to tank and direct.

Dam.—Furnishes water-power for manufactories and pumping; rollway, 446 ft. long, 14 ft. high; one end bedded to ledge, other extends about 50 ft. into bank; 5 ft. wide on top, 34 at bottom, with apron extending 10 ft. from foot of outer slope. Built of hemlock logs, checks 6 ft. sq., filled with rock and gravel; planked on upper, or wet slope, with 3-in. spruce plank, on top and down lower slope with 4-in. birch, on apron with 6-in. birch plank. *Gates*: 3 at each end, each 6⅔ ft. in clear; each set of gates protected by pier 10 ft. higher than main dam, and covered with gate-house, 12 × 22 ft.; one gate used for water-works. Total available H. P., about 1,500; for lease, 1,200. Built in '89. Engrs., see History. Contr., T. J. Emery, Waterville. Cost, $30,000.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Blake dup., water-power. *Water-wheel*: 140 H. P.; made by P. C. Holmes Co., Gardiner.

Tank.—Cap., 151,000 galls.; 30 × 29½ ft.; on hill 213 ft. above pump. Contr., E. Hodge & Co., E. Boston, Mass.

River Crossing.—An 8-in. trussed pipe-bridge, 32 ft. long. Full details are given in the *Engineering and Building Record*, Dec. 28, '89.

Distribution.—*Mains*, 8 and 6-in., c. i., 4 miles. *Services*, galv. i. Pipe from R. D. Wood & Co., Philadelphia, Pa.; specials, Builder's Iron Foundry, Providence, R. I.; trenching and pipe-laying done by Daniel Dacy, Boston, Mass. *Hydrants*, Mathews, 26. *Valves*, Eddy.

Financial.—Cost, about $100,000. Cap. stock, $60,000. Bonded debt, $80.000. Int. 5%, Hydrant rental, exemption from taxation and $80 for 25, $40 for additional.

Management.—Prest., Geo. I. Trickey. Secy., Treas. and Mgr., H. M. Heath, Augusta. Supt., A. B. Fisher. Latest report, Sept. 18, '89.

CUMBERLAND MILLS, *Cumberland Co.* See Portland.

DEERING, *Cumberland Co.* See Portland.

DIAMOND ISLAND, *Cumberland Co.* (Pop., est, 400.) Small island in Portland harbor, upon which are a few summer cottages.

History.—Built in '87 by Diamond Island Water Co. under absolute and perpetual franchise.

Water Supply.—Springs, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., not given. Three wind engines.

Stand-Pipe.—Cap., 175,000 galls.

Distribution.—*Mains*, rustless i., 4 miles. *Consumption*, 5,000 galls,

Financial.—Cost, $10,000. Cap. stock, $5,000. Bonds, $5.000. Int., 7%. Ann. op. exp., withheld, est., $300 Ann. rev., withheld, est., $2,000.

Management—Prest., Franklin M. Lawrence, Sec. and Treas., Seth L. Larrabee, Portland.

DOVER and FOXCROFT, *Piscataquis Co.* (Pop.: Dover, 1,647; est.' 4,000. Foxcroft, town, 1.263.) On opposite sides Piscataquis river. Engaged in manufacturing. Not incorp. No sewers or electric lights.

History.—Built in '87 by Dover and Foxcroft Water Co., under 40-years charter. Const. Engr., F. Danforth, Gardiner. Contr., J. J. Newman, Providence, R. I.

Water Supply.—Piscataquis river, pumping to reservoir.

Pumping Machinery.—Dy. cap., 1,250,000 galls.; Deane.

Reservoir.—Cap., 750,000 galls.

Distribution.—*Mains*, c. i., 7 miles. *Services*, tarred i. Pipes and specials from Warren Foundry and Machine Co. *Taps*, 190. *Meters*, none. *Hydrants*, Chapman, 30. *Consumption*, 45,000 galls. *Pressure:* 70 lbs.

Financial.—Cost, withheld, est., $360,000. Cap. stock and bonds, $160,000. Debt, $60,000. Int., 5%. Ann. rev.: consumers, withheld, est., $6,000; city, $1,500. Hydrant rental, $50.

Management.—Prest., Weston Lewis. Treas., Josiah D. Maxey. Both of Gardiner. Supt., Jno. P. Crocker.

EASTPORT, *Washington Co.* (Pop., 4,006; est., 5,000.) On Moose Island, in Passamaquoddy bay, at mouth of St. Croix river. Summer resort. Engaged in commerce, fishing and canning industries. No sewers. Has electric lights

NOTE.—Unofficially reported latter part of Nov., '89, that works had been com-

pleted in '89, and that $50,000 extensions would be made. Officially reported June 6, '89, that city was to pay $1,000 a year for hydrants, and that officers were: Prest., Saml. D. Leavitt. Secy. and Treas., N. B. Nutt. Supt., J. F. Campbell. Works were projected by local company in '87, and by National Water-Works Syndicate, Boston, Mass., in '88. No further data can be obtained.

ELLSWORTH, *Hancock Co.* (Pop., 5,052; est., 6,000.) On Union river, 26 miles from Bangor. Engaged in ship-building and lumber trade. Incorp. a city. No sewers Has electric lights

History.—Built in '89-'90 by Ellsworth Water Co.; put in operation Jan., '90, Engr., E. A. Cummings Contrs., Jos. Westcott & Sons, Portland.

Water Supply.—Branch Pond stream, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 1,750,000 galls; Deane dup.

Stand-Pipe.—Cap., 300,000 galls.; from Portland Boiler Works.

Distribution.—*Mains*, 10-in., material not given, 6¼ miles. *Hydrants*, Mathews, 52.

Pressure: Ordinary, 100 lbs. Fire, 115 lbs.

Financial.—Cost, withheld, est., $75,000. Hydrant rental, total of $1,800, or about $35 each.

Management.—Prest., Nathan Cleaves, Portland. Secy., A. W. King. Treas., J. E. Parsons. Supt., A. H. Cushman.

NOTE.—Latest report, March 1, '90. Further data not determined, or withheld.

FAIRFIELD, *Somerset Co.* See Waterville.

FORT FAIRFIELD, *Aroostook Co.* (Pop., est., 4,000.) On Aroostook river. Incorp, village in '87. No sewers or electric lights.

History.—Built in '89 by Frontier Water Co; put in operation Oct. 1, '89. Engr., E. H. Gowing.

Water Supply.—Grass brook, by gravity.

Reservoir.—Cap., 1,000,000 galls.

Distribution.—*Mains*, 12 and 10-in. c. i., 2½ miles. *Services*, galv. i *Hydrants*, Ludlow, 17. *Valves*, Ludlow.

Pressure: about 60 lbs.

Financial.—Cost, about $30,000. Bonded debt, $30,000 Bonds authorized, $150,000. Int., 5%. Ann. op. exp., nominal. Hydrant rental, $50.

Management.—Prest., N. Fessenden. Secy. and Supt., E. L Houghton. Treas., J. F. Hacker.

NOTE.—Latest report, March 1, '90. Works completed too late in season to put in many services.

FOXCROFT, *Piscataquis Co.* See Dover.

FRYEBURG, *Oxford Co.* (Pop., est., 1,600.) On a level, sandy plain, with out-lying granite hills 100 to 1,000 ft. high. Settled in 1763; incorp. since. No sewers or electric lights.

History.—Built in '82 by Fryeburg Water Co. Des. Engr., D. L. Lamson. Const. Engr. A. R. Jenness, the present Supt.

Water Supply.—Mountain stream, by gravity from reservoir. Drainage area, 800 acres.

Dam and Reservoir.—Cap., not given; 60 x 100 ft.; three miles from and 155 ft. above village; usually fed with 2,000,000 dy. Dam of granite masonry in cem.

Conduit.—C. i, 10 and 6 ins. in diam.

Distribution.—*Mains*, c. i., 6½ miles. *Services*, tarred c. i. *Taps*, 130. *Meters*, none. *Hydrants*, Mathews, 23.

Consumption, 20,000 galls. *Pressure*, 55 to 60 lbs.

Financial.—Cost, $20,000. Paid up stock, $17,000. No debt. Ann. op. exp., $50 to $75. Ann. rev.: consumers, $1,700; city, $100. Hydrant rental, $5.

Management.—Prest, Thomas C. Shirley. Secy. and Treas., D. L. Lamson. Supt, A. R. Jenness.

GARDINER and RANDOLPH, *Kennebec Co.* (Pop.: Gardiner, 4,439; est., 6,000. Randolph, est., 1,100.) At head of steamboat navigation, on opposite sides Kennebec river. Engaged in manufacturing and commerce, especially lumber trade. Incorp. No sewers. Has electric lights.

History.—Built in '85 by Gardiner Water Co., under 20-years' franchise. Engr. M. M. Tidd, Boston, Mass. Contr., J. J. Newman, Providence, R. I. In '88 works,

were extended to Randolph by laying 1,000 ft. of pipe across Kennebec river. Contr., H. G. Dennis, New Bedford, Mass.

Water Supply.—Cobbcssee Contee river, pumping from impounding to distributing reservoir.

Dam and Impounding Reservoir.—Not described. Is 124 ft. above tide.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Blake dup., water-power, 12 x 18 ins.

Reservoir.—Cap. 2,000,000 galls.; 112 ft. above dam, 236 ft. above tide, and 212 ft. above lower streets of village.

Distribution.—*Mains*, c. i., 14 miles. *Services*, tarred w. i. *Taps*, 726. *Meters*, 4. *Hydrants*, Chapman, 64; 10 being in Randolph.

Consumption, 200,000 galls. *Pressure*, 90 lbs.

Financial.—Cost, withheld, but est., $180,000. Cap. stock, $250,000. Bonded debt, $120,000. Int., 5%. Ann. rev.: consumers, withheld, est., $16,000; city, $3,200. Hydrant rental, $50.

Management.—Prest., Weston Lewis. Secy. and Treas., Josiah S. Maxcy. Supt., Gustavus Moore.

HALLOWELL, *Kennebec Co.* (Pop., 3,154; est., 3,500.) On Kennebec river. Exports granite and ice. Has some manufactories. Incorp. No sewers. Has electric lights.

History.—Built in '76 by Hallowell Water Co.

Water Supply.—Springs collected in reservoirs, thence by gravity to village.

Reservoirs.—Combined cap., est., 500,000 galls. Three. One 80 ft. sq. and 9 ft. deep, 100 ft. above city. Others 65 ft. above city; one 20 ft. sq. and 9 ft. deep, one 80 x 90 ft.

Distribution.—*Mains*, c. i , w. i., 5 miles. *Services*, galv. i.; originally rubber coated i., which stood well in some places and corroded badly in others. *Taps*, about 175. *Meters*, none. *Hydrants*, Whittier, 1.

Consumption, unknown. *Pressure*, 100 lbs., down

Financial.—Cost of works, $21,000. Debt, $3,600. Int., 6%. Ann. op. exp , withheld, est., $500. Ann. rev.: consumers, $1,250.

Management.—Prest., J. F, Bodwell. Secy., Treas. and Supt., Orlando Currier.

HOULTON, *Aroostook Co.* (Pop. 3,228; est., 4,000) Engaged in farming and manufacturing. Not incorp. Has sewers and electric lights.

History.—Built in '85, by Houlton Water Co., under perpetual charter. Engrs., Crafts & Forbes, Boston, Mass. Contrs., Ferris & Halladay, Jersey City, N. J.

Water Supply.—Surface water from stream fed by springs, pumping to standpipe.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; two 500,000 Worthington. *Boilers:* from Whittier Machine Co., Boston, Mass.

Stand-Pipe.—Cap., 116,000 galls.; iron, 20 x 50 ft.; on 10 ft. of masonry. Made by Kendall & Roberts.

Distribution.—*Mains*, c. i., 5 miles. *Services*, enam. i. Pipes and specials from Warren Foundry & Machine Co., Phillipsburg, N. J. *Taps*, 170. *Meters*, 2. *Hydrants*, Mathews, 30. *Gates*, Coffin.

Consumption, 60,000. *Pressure:* ordinary, 50 lbs. Fire, 100 lbs.

Financial.—Cost, $55,000. Cap. stock, $50,000. No debt. Ann. op. exp., $2,500. Ann. rev.: consumers, $3,000; city, $1,650. Hydrant rental $75 each for 22 only.

Management.—Prest., Walter Mansur. Secy., Treas. and Supt., James Frank Holland.

KENNEBUNK, *York Co.* (Pop., 2,852; est., 3,000.) Engaged in manufacturing shoes and leather goods. No electric lights.

History.—Built by town for fire protection only. Date not given. **Water Supply.**—By pumping. **Pumping Machinery.**—One Deane pumping engine and two water-power force pumps. **Distribution.**—*Mains*, c. i., 1,900 ft. *Hydrants*, 4. No further data given. Address W. L Dane.

LEWISTON, *Androscoggin Co.* (Pop., 19,083; est., 23,500.) On Androscoggin river, on undulating ground rising from the river to hills 350 ft. high. Opposite city the river falls 70 ft., affording good water-power used for manufacturing cotton and

woolen goods, boots and shoes, lumber and machinery. Incorp. a town in 1795; chartered as city in '63. Has sewers and electric lights.

History.—Built by city in '78-9. Engr., M. M. Tidd, Boston, Mass.

Water Supply.—Androscoggin river, pumping to reservoir. Source of river is a chain of mountain lakes 100 miles above Lewiston; drainage basin, 80 sq. m.

Dam.—Across river. Owned and maintained by Union Water Power Co. Cost, $38,825.

Brick Conduit.—Takes water from pond above falls, through filter to pump-well.

Filter.—Sea gravel and sand in arched gallery leading from head gates to screen well; area, 400 sq. ft.; depth, 32 ins. Cleaned once a week.

Pumping Machinery.—Dy. cap. 3,000,000 galls. Two Worthington dup. water-power, with four 17½ × 33-in. plungers, making 9 strokes a minute, and a 26-in. pump barrel. *Water-wheels:* Two 54-in. Risdon turbines, working under 25-ft. head, making 80 revolutions per minute.

Force Main.—C. i., 24-in., 10,450 ft. long; rise, 200 ft.

Reservoir.—Cap., 14,000,000 galls.; in excavation and embankment, on hillside, 220 ft. above general level of city, one side level with natural earth, other consists of earth embankment 15 ft. wide on top, inner slopes lined with cobble-stones; outer slope, 2 to 1. *Heart-wall:* 16-ins. brick in cem.

Distribution.—*Mains*, 24 to 8-in. c. i., 28 miles. *Services*, w. i. Pipes and specials from McNeal Pipe & Foundry Co., Burlington, N. J. *Taps*, 2,064. *Meters*, 70. *Hydrants*, Chapman, 156. *Valves*, Chapman.

Consumption, not known. *Pressure*: Ordinary, 65 to 90 lbs. Fire, 65 to 120 lbs.

Financial.—Cost, $563,467. ($200,000 for water-power and privileges.) Bonded debt, $542,417. Sinking fund, $50,000. Int., 5%. Ann. op. exp., about $6,000. Ann. rev.: consumers, about $29,000; city, about $5,000. Hydrant rental, $40. Original cost, $500,000.

Management.—Seven Comrs., one elected by City Council each year. Prest., T. F. Callahan. Clerk, Walter A. Goss. Supt., Isaac C. Downs.

LITTLE FALLS, *Cumberland Co.* See Portland.

NORTH ANSON, *Somerset Co.* (Pop., est., 1,550.) On Kennebec river, 19 miles from Skowhegan. Engaged in manufacturing and lumber trade. No electric lights.

History.—Built in '83 by town and Potter & Watson, jointly, for fire protection. Town owns pump and P. & W. boiler; distribution paid for by money raised by subscription. **Water Supply.**—Stream, direct pumping. **Pumping Machinery.**—Dy. cap., 500,000 galls.; Deane dup. **Distribution.**—*Mains*, 6 and 3 in. w. i., ½ mile. *Hydrants*, 6. *Pressure:* 75 lbs. **Financial.**—Cost, $4,000.

NORWAY and SOUTH PARIS, *Oxford Co.* (Pop.: Norway, 1,467; est., 3,400. South Paris, est., 1,600.) Engaged in manufacturing. Incorp. No sewers. Both villages have electric lights.

History.—Built in '86 by National Water-Works Syndicate, Boston, Mass., but now under a different management, not given.

Water Supply.—Lake and river, pumping to reservoir.

Pumping Machinery.—Dy. cap., 1,250,000 galls.; Worthington.

Reservoir.—Not described.

Distribution.—*Mains*, 12 to 6 or 4-in., material not given, 7 miles. *Services*, not given. *Taps*, 400. *Meters*, 1. *Hydrants*, probably Chapman, 54. *Valves*, Chapman.

Consumption, 50,000 galls. *Pressure:* 80 to 100 lbs.

Financial.—Cost, $65,000. Bonded debt, $50,000. Int., 5%. Ann. op. exp., $1,000. Ann. rev.: consumers, $2,500; city, $2,500. Hydrant rental, $45. Original cost, $42,000.

Management.—Prest. W. H. Whitcomb. Secy., H. D. Smith. Treas. and Supt., W. W. Whitmarsh.

OLD ORCHARD, *York Co.* (Pop., est., winter, 1,000; summer, 5,000.) On Saco Bay. Summer resort. Not incorp. Has sewers and electric lights.

History.—Built in '87 by Old Orchard Water Co., under a 20-years franchise. Engrs., B. R. Clarke and M. M. Tidd. Contrs., Turner, Clarke & Rawson. All of Boston, Mass.

Water Supply.—Spring, by gravity to and from reservoir, with direct pumping for fire protection.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Blake simple dup., high-pressure. *Boiler:* Herreshoff.

Reservoir.—Cap., 390,000 galls.; at spring, roofed.

Distribution.—*Mains*, c. i., 7 miles. *Services*, galv. i. *Taps*, 78. *Meters*, none reported. *Hydrants*, Chapman, 25 *Valves*, Chapman.

Consumption, not given. *Pressure:* Ordinary, 40 lbs. Fire, 100 lbs

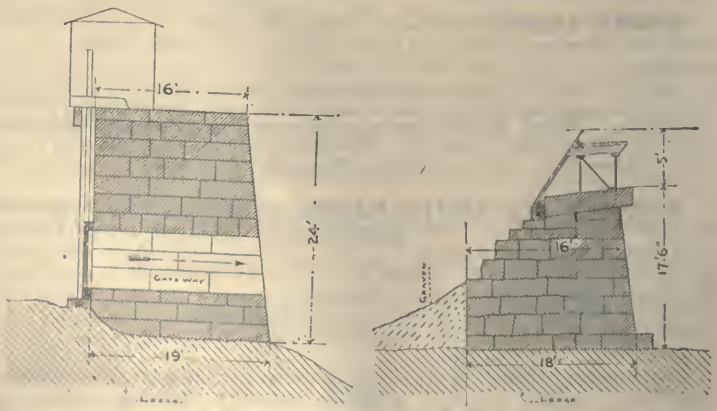
Financial.—Cost, withheld, but est., $60,000. Cap. stock, $75,000. Bonds, none in '88. Ann. op. exp., withheld, est., $3,000. Ann. rev: consumers, withheld, est., $5,300; city, $1,000 Hydrant rental, $40.

Management.—Prest. A. B. Turner. Treas., J. Wentworth Brown. Both of Boston. Supt., J. W. Duff.

PORTLAND, *Cumberland Co.* (Pop., 33,890; est., 40,000. Combined pop. of Portland, Deering and Westbrook, est., 52,000.) On peninsula in Casco Bay, ¾ mile wide by 3 miles long. Land rises each way from center of city to elevations of 161 and 175 ft. Engaged in commerce and shipping interests and manufacturing. Settled in 1632; incorp. town in 1786; city in '32. Has sewers and electric lights.

History.—Built in '67-9 by Portland Water Co., which has since supplied villages along pipe line from Lake Sebago through townships of Deering and Westbrook. Villages and years first supplied are: Cumberland Mills, '70; Deering, '79; Little Falls, '70; Saccarappa, '70, and Westbrook, '70. Distributing systems for these villages were put in, and are now owned and operated by the Portland Water Co. Previous to '69 water had been taken wholly from wells and cisterns. Engrs. and Contrs., Ferris & Halliday, Jersey City, N. J., then known as American Water-Works & Gas Pipe Co.

Water Supply.—Lake Sebago, by gravity through 16 miles of pipe to city. The Presumscot River is the only outlet of the lake, and the supply in river is regulated by a dam at its head. Lake Sebago is 14 miles long, 6 wide, is fed by over 40 smaller lakes and ponds; area, 100 sq. miles; drainage area, 500 sq. miles. The water in the lake is 267 ft. above the level of the city.



Section through Gate-Way. *Section through Spillway.*

Dam at Lake Sebago, Portland, Me.

Dam.—Built in '78 by Presumscot Water Co., to raise level of lake; masonry in cement, 120 ft. long on rollway. Wasteway is at end of rollway; consists of 5 culverts, each 4 ft. wide by 6 ft. high, controlled by gates. For dimensions and further details see accompanying sections through gateway and spillway. Dam leaks scarcely at all; cost, $59,000. Des. Engr., Jno. E. Warren. Const. Engr., Chas. R. Goodell. Both of Cumberland Mills. Work mostly done by owners.

Intake.—Box conduit 4 ft. sq.; extends 80 ft. into the lake, is fitted with screens, and terminates at a gate-house on the bank, 27x33 ft.

Brick Conduit and Tunnel.—Together, 5,440 ft. long, with fall of 1½ ft., ending in a second gate-house, 15 ft. sq. First 2,000 ft., 2½x3½-ft. brick conduit, ending in

tunnel 3½ ft. high, 6 ft. wide, 1,360 ft. long, from which brick conduit 2,080 ft. long leads to the second gate-house.

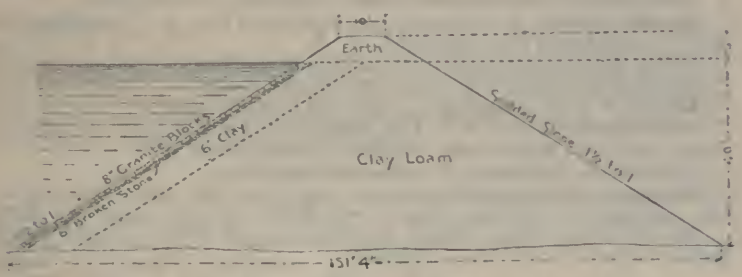
Conduits.—Combined dy cap , est., 9,441,000 galls.; 2 w i. and cem. pipes, leading side by side from second gate-house to city, about 15 miles.

High-Service Conduit.—Is 20 ins. in diam., and is now connected with low-service by means of a 12-in. automatic pressure-valve, which opens only when pressure in high-service pipes is more than 20 lbs. on highest level. Laid in '68-'9.

Low-Service Conduit.—First 4 miles to Ward's hill are of 36-in. pipe, laid in '76. Since then a 24-in. pipe has been laid to city, and with two reservoirs forms the low service. This conduit connects with Branchall's reservoir by means of a 12 in. automatic pressure-valve, which opens both ways, admitting water to reservoir when pressure at highest point of low-service reaches 20 lbs., and allowing water to flow from reservoir when pressure in low-service is less than that in reservoir.

Reservoirs.—Combined cap., 30,000,000 galls.; two used for low service. Branchall reservoir built in '68-9, and the Munjoy in '88-9, to receive surplus from low-service, and act as reserve. Both reservoirs are used for low-service.

Branchall's Hill Reservoir: Cap., 10,000,000 galls.; in embankments nearly square. Area of high water surface, about 60,000 sq. ft.; bottom, about 32,000 ft.; depth, about 28 ft. Banks, 20 ft. thick on top, have inner and outer slopes of 1½ to 1; inner slopes covered with 18 ins. of puddling, above which is 8 ins. of stone riprap.



Section Munjoy Hill Reservoir Embankment, Portland Me

Munjoy Reservoir: Cap., 20,000,000 galls.; area, 4 acres. Water stands 153 ft. above mean low water in bay. See accompanying section of embankment. Cost, $125,000. Engr., J. Herbert Shedd; Contr., Jas. J. Newman, both of Providence, R I. For description of bursting of reservoir, see MANUAL for '88.

Munjoy Supply Main.—Diam., 12 ins.

Distribution.—*Mains*, including supply mains, 26 to 2-in. c. i., 98 miles; first mains, w. i. and cem., but when hydrants and elevators were put in they did not stand pressure, so were replaced with c. i. Original mains were furnished by Contrs. In '82 lead joints in main under Little river continually blew out. An air-valve near the dip in main did no good, but a pile and timber foundation under 50 ft. of main stopped trouble. *Services*, galv. i.; water is so soft that it rapidly oxidizes plain iron pipe. *Taps*, 6,700. *Meters*, 199. *Hydrants*, Mathews, Whittier, 414; 295 in Portland, 64 in Westbrook and 55 in Deering. *Pressure-recording gauge*, Edson. *Extensions in* '89, 10 miles, 12 to 6 in. mains, 75 hydrants, 25 meters.

Consumption, 5,000,000 galls. *Pressure*: Ordinary and fire, 60 lbs.

Financial.—Cost withheld, but est., $2,500,000. Cost to Jan., '80, $2,251,000. Debt, $1,500,000: $400,000 at 6%, $75,000 at 5%, and $1,025,000 at 4%. Sinking fund, $7,500. Ann. op. exp., $16,000. Ann. int., $68,750. Ann. rev.: consumers, not given, est, $145,000; cities; $5,950 from Westbrook and Deering. Hydrant rental: Portland, free; Westbrook and Deering, $50.

Management.—Prest., D. W. Clark. Secy., E. R. Payson. Treas. and Supt., Geo. P. Westcott.

PRESQUE ISLE, *Aroostook Co.* (Pop., 1,305; est., 2,500.) On Presque river. Town engaged in agriculture, lumbering and manufacturing. Incorp. Has sewers and electric lights.

History.—Built in '87 by National Water-Works Syndicate, Boston, Mass.; now controlled by other parties. Engrs., Crafts & Forbes, Boston, Mass.

Water Supply.—Kennedy brook, by gravity, with pumping in case of emergency.

Impounding Dam and Reservoir.—Cap., est., 25,000,000 gals.; area, 4 acres; 1¼ miles from village, with broad swale below. Dam is of logs, planked, and covered with gravel; 215 ft. long on crest, 17 ft. high, 35 ft. thick at base. *Spillway:* wood, 66 ft. from end of dam, 10 ft. long; free. Top of water is 12 ins. below top of dam. *Discharge-pipe:* 12 in. Dam does not leak badly. Engr., A. W. Forbes, Boston, Mass. Contrs., J. & A. Crouse, Presque Isle. Cost, $2,000.

Pumping Machinery.—Dy. cap., 1,000,000 galls; Worthington. *Boiler:* Whittier quick steaming.

Distribution.—*Mains*, kind not given, 4¼ miles. *Services*, not given. *Taps*, 85. *Meters*, none. *Hydrants*, kind not given, 10.

Consumption, not given. *Pressure*, 100 lbs.

Financial.—Cost, $30,000. Capital stock, $30,000. Bonds, $30,000. Int., 5%. Sinking fund, none. Ann. op. ex., about $200. Ann. rev.: consumers, $1,200; city, $600. Hydrant rental, $60.

Management.—Prest. and Supt., Geo. H. Freeman. Secy., Chas. P. Allen. Treas., D. A. Boody, 57 Broadway, New York City.

RANDOLPH *Kennebec Co.* See Gardiner.

RICHMOND, *Sagadahoc Co.* (Pop., est., 2,800.) Is 17 miles south of Augusta. Manufactures boots, shoes and lumber. No sewers or electric lights.

History.—Built in '86 by company; put in operation Dec., '86. Const. Engr. and Contr., J. J. Newman, Providence, R. I.

Water Supply.—Kennebec river, pumping to reservoir.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Blake.

Reservoir.—Cap., 1,000,000 galls.; earth; 200 ft. above river.

Distribution.—*Mains*, 12 to 6-in., material not given, 8 miles. *Services*, not given. *Taps*, 195. *Meters*, none. *Hydrants*, kind got given, 41.

Consumption, 75,000 galls. *Pressure:* not given.

Financial.—All withheld, but ann. rev. from city, $2,050, and hydrant rental, $50. *Estimates:* Cost, $100,000. Ann. op. exp., $2,750. Ann. rev: consumers, $8,000.

Management.—Prest., Weston Lewis. Secy. and Treas., Josiah S. Maxcy. Both of Gardiner. Supt., Jno. L. Pushard.

ROCKLAND, CAMDEN and THOMASTON, *Knox Co.* (Pop.: Rockland, 7,599; est., 7,700. Camden, 4,386; est., 4,500. Thomaston, 3,017; est., 3,017.) Rockland, on Penobscot bay; engaged in ship building and commerce. Incorp. a city in '54. Camden, on Penobscot bay, 8 miles north of Rockland; engaged in ship-building, ice-cutting and manufacture of lime. Thomaston is on Georges river, 4 miles west of Rockland; engaged in ship-building and manufacture of lime. Rockland incorp., Camden and Thomaston are not. Each village has sewers and electric lights.

History.—First supplied in '51 by Rockland Water Co., which had a monopoly until '85, when Camden and Rockland Water Co. began to operate competing works. In '87, latter works were extended to supply Camden and Thomaston. Engr., Percy M. Blake, Hyde Park, Mass.

Water Supply.—Lake, 7 miles distant, fed by mountain springs, by gravity to reservoir.

Reservoir.—Cap., 2,500,000 galls.; on Juniper hill, reported as having clay walls, gravelled, with sides and bottom lined with granite blocks.

Distribution.—*Mains*, 80 miles; from R. D. Wood & Co., Philadelphia, Pa., and Warren Foundry and Machine Co., Phillipsburg, N. J. *Services, Taps and Meters*, not given. *Hydrants*, Mathews, Ludlow, 112. *Valves*, Mathews, Ludlow.

Consumption, not given. *Pressure:* Rockland, 95, Camden, 130, and Thomaston, 95 lbs.

Financial.—Cost, withheld, est., $600,000. Cap. stock, bonds, debt and int., withheld. Ann. op. exp., withheld, est., $10,000. Ann. rev.: withheld, est., $50,000; cities, $5,600. Hydrant rental, $50.

Management.—Prest., A. G. Crockett. Secy. and Treas., W. S. White. Clerk and Supt., J. W. Crocker.

SACCARAPPA, *Cumberland Co.* See Portland.

SACO, *York Co.* See Biddeford.

SANFORD, *York Co.* (Pop., est., 2,500.) Has cotton and woolen manufactories. Incorp. town. No sewers. Has electric lights.

History.—Built in '87 by Sanford Light & Water Co., under direction of E. M. Goodall, without Engr.

Water Supply.—Springs, by gravity; direct pumping for fire purposes and pumping to tank.

Pumping Machinery.—Dy. cap., not given. A 20-ft. eclipse windmill drives a 25,000-gall. pump, and in case of fire connection is made with pumps in mills.

Tank.—Cap., 52,000 galls.; 24 x 18 ft.; from L. H. Wheeler, Boston, Mass.

Distribution.—*Mains*, 6-in., 2 miles or more. *Services*, not given. Pipes and specials from R. D. Wood & Co., Philadelphia. *Taps*, 200. *Meters*, none. *Hydrants*, Chapman, 16. *Valves*, Chapman.

Consumption, 7,000 galls. *Pressure*: Ordinary, 20 lbs.; fire, 65 lbs.

Financial.—Cost, $12,000. Cap. stock, $10,000. Debt, $3,000, in notes. Int., 6%. Ann. op. exp., $100. Ann. rev.: consumers, $1,600; city, none. Hydrants were put in by subscription, and rental is free.

Management.—Prest. and Supt., E. M. Goodall. Secy., E. E. Hussey. Treas., Geo. H. Howell.

SKOWHEGAN, *Somerset Co.* (Pop., 2,609; est., 5,000.) On Kennebec river. Engaged in lumbering, manufacturing and farming. Incorp. Partially sewered. Has electric lights.

OLD AQUEDUCT CO.'S WORKS

General Description.—About '50 an Aqueduct Co. began to supply water, and since then 5 others have been established. Supply has been from springs by gravity. In '80 main conduit was 2 miles long, 4 and 3 ins. in diam., and had a dy. cap. of 200,000 galls., under head of from 10 to 25 ft. There were then between 2 and 3 miles of 4 to 1½-in. distributing mains, and between 300 and 400 water takers. Original cost, about $15,000. In '89 there were about 150 takers.

SKOWHEGAN WATER CO.'S WORKS.

History.—Built in '87 to Feb., '89, at first under control of National Water Works Syndicate, Boston, Mass.,, but in Aug., '88, all connections with syndicate were severed. Des. Engr., Geo. Alexander, Boston, Mass. Const. Engr., E. H. Gowing, Boston. Work done by company.

Water Supply.—Springs, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two 1,000,000 Worthington. comp., cond., dup. *Boilers:* two 90 H. P. horizontal, tubular.

River Crossing.—One channel of river crossed by 360 ft. of 8-in. pipe, having Ward's joints.

Stand-Pipe.—Cap., 275,000 galls.; 25 x 75 ft.; from E. Hodge & Co., E. Boston, Mass.

Distribution.—*Mains*, c. i., length not given; from M. J. Drummond, New York. *Services*, galv. i. *Taps and meters*, not given. *Hydrants*, Mathews, 75. *Valves*, Ludlow.

Consumption, not determined. *Pressure*: 70 to 90 lbs.

Financial.—Cost, $116,000. Cap. stock, $200,000. Bonded debt, $85,000. Int., 5%. Ann. op. exp. about $1,600. Ann. rev.: consumers, not determined; city, $2,000. Hydrant rental, $26.66; 20-years contract from fall of '89.

Management.—Prest., R. B. Shepherd. Secy., J. C. Griffin. Treas., A. R. Bixby. Supt., Jas. M. Holt. Managing Director, C. M. Brainard.

SORRENTO, *Hancock Co.* (Pop., not given.) Sewers and electric lights put in in '89.

History.—Built in '87 by the Frenchman's Bay & Mt. Desert Land and Water Co., 17 Milk St., Boston, Mass., under charter granted to Long Pond Co., of Sullivan, Me.

Water Supply.—Long Pond, by gravity to and from reservoir. Pond is about 5 miles from village and 230 ft. above sea.

Dam.—At lake; of wood, small.

Conduit.—Five miles of w. i., size not given, leading from lake to reservoir.

Reservoir.—Cap., about 90,000 galls.; masonry, 30 x 50 ft x 10 or 12 ft. deep; about 150 ft. above sea.

Distribution.—*Mains*, 6 miles. *Meters*, none. *Hydrants*, 10. No other data given.

Financial.—Cost, $20,000. Debt, not given. Ann. op. exp. $1,000. Ann. rev.: consumers, not given; est., $3,000; city, not given.

Management.—Prest., Chas. H. Lewis. Treas., J. Wesley Kimball. Both of Boston. Secy., Chas. P. Simpson.

SOUTH NORRIDGEWOCK, *Somerset Co.* (Pop., not given.)

History.—Built in '88 by Henry K. Sawyer.

Water Supply.—Spring, pumping to tank. Spring about 12 ft. in diam., 8 ft. deep, bricked.

Pumping Machinery.—Steam pump.

Tank.—Cap., 15,000 galls.

Distribution.—*Mains*, 1 mile. *Consumers*, 50.

Financial.—Cost, not given, est., $5,000.

Management.—Owner, H. K. Sawyer. Report by W. E. Bruce.

NOTE:—There are two other smaller plants, also private.

SOUTH PARIS, *Oxford Co.* See Norway.

SPRINGVALE, *York Co.* (Pop., 1,116; est., 1,300.) On Mousam river, 12 miles from Rochester, N. H. Engaged in lumber and general trade; has cotton and shoe factories. No sewers or electric lights.

SPRINGVALE AQUEDUCT CO.

History.—Built in '76; works designed by one of the owners, M. Dennett, and constructed by Co.

Water Supply.—Pond, by gravity. Pond covers 40 acres; 1¼ miles from, 167 ft. above, village.

Conduit.—Iron, 4½ ins. in diam., about 1¼ miles long.

Distribution.—(In '87) *Mains*, c. i., 3 miles. *Services*, w. i. *Taps* (in '84,) 150. *Meters*, none. *Hydrants*, plain 2-in., 4.

Consumption, not given. *Pressure*, 40 lbs.

Financial.—Cost (in '87) $10,000. First cost, $7,000. No other data given.

Management.—(In '88) Prest., Saml. D. Tibbett. Treas., Clerk and Supt., Jno A. Bennett.

NOTE.—Requests for later and more complete information ignored.

BUTLER SPRING WATER CO.

History.—Built in '89. Engr., E. F. Davenport, the present Supt.

Water Supply.—Springs, pumping to tank.

Pumping Machinery.—Dy. cap., 86,000 galls.; Silsby.

Tank.—Cap., 30,000 galls.; from Challenge Wind & Feed Mill Co., Batavia, Ill.

Distribution.—(To Nov. 1, '89.) *Mains*, c. i., 2½ miles; from R. D. Wood & Co., Philadelphia, Pa. *Services*, rustless i. *Taps*, 75. *Meters*, none. *Hydrants*, Mathews, Chapman, 2. *Valves*, Eddy.

Consumption, not determined. *Pressure*: 40 lbs.

Financial.—Cost, about $10,000, Cap. stock, $25,000. Debt, none. Other data not determined.

Management.—Prest., Irving A. Butler. Secy. and Treas., T. A. Clark. Supt., E. F. Davenport.

THOMASTON, *Knox Co.* See Rockland.

WATERVILLE and FAIRFIELD, *Kennebec Co.* (Pop., Waterville, 1,917: est., 7,000. Fairfield, not given; est., 5,000.) Both villages on Kennebec river, and engaged in manufacturing. Waterville has sewers and electric lights.

History.—Built in '87 by Waterville Water Co., under 20-years franchise. Engr. H. G. Dennis, New Bedford, Mass. Contr., J. J. Newman, Providence, R. I.

Water Supply.—Messalonskee river, pumping to reservoir.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; Deane.

Reservoir.—Cap., 3,000,000 galls.

Distribution.—*Mains*, c. i., about 18 miles. *Services*, tarred, i. Pipe and specials from McNeal Pipe and Foundry Co. *Taps*, not given. *Meters*, 10. *Hydrants*, Chapman, 82.

Consumption, 375,000 galls. *Pressure*: 85 lbs.

Financial.—Cost, withheld, est., $150,000. Cap. stock and bonds, $100,000. Int. 5%. Ann. op. exp., withheld, est., $6,000. Ann. rev.: consumers, withheld, est., $14,000; city, $3,280. Hydrant rental, $40.

Management.—Prest., Weston Lewis. Treas., J. S. Maxcy. Both of Gardiner. Supt., Jno. F. Nash.

WESTBROOK, *Cumberland Co.* See Portland.

WINTHROP, *Kennebec Co.* (Pop. est. 1,000.) Ten miles west of Augusta. Engaged in manufacturing oil-cloth, blankets and agricultural implements. Not incorp. No sewers or electric lights. **History.**—Built by village and private subscriptions in '83, for fire protection only. **Water Supply.**—Source not given. By gravity and pumping. **Pumping Machinery.**—Force pumps placed in, and driven by power from factory of Winthrop Mill Co. **Distribution.**—*Mains*, c. i., 3,000 ft *Hydrants*, Matthews, 10. **Financial.**—Cost, $5,000, of which $3,500 was raised by the town, and $1,500 by subscription. **Management.**—Chf. Fire Dept., C. A. Wing. Village Clerk, C. O. Relley.

YORK BEACH, *York Co.* (Pop., est., summer, 3,500.) Summer resort. Has sewers.

History.—Built in '88 by H. E. Evans, York Village, and Chas. E. Carter, Lowell, Mass.; known as York Beach Water Co. Used only in summer. Des. Engr., H. E. Evans, York Village.

Water Supply.—Artesian wells, pumping to tank.

Pumping Machinery.—A 90,000-gall. Worthington dup.

Tank.—Cap., 25,000 galls

Distribution.—*Mains*, galv. i., 3 miles. *Services*, galv. i. *Taps*, 60. *Meters* and *Hydrants*, none.

Financial.—Cost, $10,000. Debt, none. Ann. op. exp., $400. Ann. rev.: consumers, $1,000.

Management.—Supt., H. E. Evans.

Water Works Projected with Fair Prospect of Construction.

BETHEL, *Oxford Co.* (Pop., est., 700.)

Proposed Works.—City to build works sometime in future at est. cost of $35,000. Supply from Chapman brook, by gravity. Chn. Water Board, W. E. Skillings. Report by Geo. H. Brown, Nov. 22, '89.

OLD TOWN, *Penobscot Co.* (Pop., est., 4,000.) On Penobscot River, 12 miles north of Bangor. Engaged in lumbering and manufacturing. Incorp. a town. Sewers and electric lights projected in '89.

Proposed Works.—Penobscot Water and Power Co. began construction Oct. 26, '89, laying about 1¼ miles of pipe before winter. Company has 20-years contract with town for 60 hydrants at $50 each. Company hopes to secure further contracts. Supply, Penobscot river, pumping to stand-pipe. Mains, c. i. Services, galv. i. Prest., F. H. Clergue. Secy., M. H. Wardwell. Treas., F. M. Laughton. All of Bangor. Supt., H. T. Sparks, Brewer. Report from latter; date, Mar. 8, '90.

SEAL HARBOR, *Hancock Co.* (Pop., est., 400.) A summer resort on Mt. Desert island.

Proposed Works.—See MANUAL for '88, p. 12, for former project, on which nothing had been done as late as Nov. 23, '89. Under date mentioned a Seal Harbor party reported that C. C. Higgins, N. Y. City, would take up the project in the spring of '90.

SULLIVAN HARBOR and WEST SULLIVAN, *Hancock Co.* (Pop., summer, est., 800.) Summer resort.

Present Supply.—Wells, and pumping from large spring to tanks on higher ground.

Proposed Works.—Sullivan Harbor Water Co., chartered in '89; incorporators, Clyde D. V. Hunt and L. S. Carter, Boston, Mass.; W. O. Emery, Sullivan. Engr. in charge of surveys, Chas. P. Simpson, Sullivan. Gravity system from Long pond; est. cost, $25,000. Backed by Sullivan Harbor Land Co., 95 Milk St., Boston. Original plan was to build works in '89, but project postponed to '90.

Water-Works Projects Reported in '89 and '90, but Now Indefinite.

Cape Elizabeth, Cumberland Co. *Farmington*, Franklin Co. *Machias*, Washington Co. *Orono*, Penobscot Co. *Pittsfield*, Somerset Co. *Winter Harbor*, Hancock Co. *Yarmouth*, Cumberland Co.

NEW HAMPSHIRE.

Water-Works Completed or in Process of Construction.

BARTLETT, *Carroll Co.* (Pop., est., 500.)

History.—Built in '86-87 by Bartlett Water Co., after plans by the Prest., P. M. Watson. Labor done by Co.

Water Supply.—A mountain brook, by gravity.

Distribution.—*Mains*, 4 and 3-in. coated w. i., 1¾ miles. *Services*, kind, do. *Taps*, 70. *Meters*, not given. *Hydrants*, 17 "stand-pipes."

Consumption, "1,400 galls." *Pressure*, 50 lbs.

Financial.—Cost, $4,000. Cap. stock, $3,000. Debt, not given. Ann. op exp., $100. Ann. rev.: withheld, est., $800.

Management.—Prest., N. P. Watson, Secy. and Treas., C. H. George. Supt., Frank George.

BETHLEHEM, *Grafton Co.* (Pop., of town, 1,403.)

History.—Built in '79 by Crystal Springs Water Co.

Water Supply.—Several large springs, by gravity from receiving and distributing reservoirs.

Dam.—Cost, $14,000. Connection with works not stated.

Receiving Reservoir.—Cap., 250,000 galls.

Conduit.—Tarred c. i., 6 and 3 ins. in diam.; length not given.

Distributing Reservoir.—Cap., not given; one side is solid ledge, two sides, railroad embankments, remaining side, masonry.

Distribution.—(In '80.) *Mains*, 6 in., 6,000 ft. *Water-takers*, 40. *Hydrants*, 6.

Consumption, about 150,000 galls. *Pressure*: available head of about 150 ft.

Financial.—Cost, originally, $10,000. Av. ann. op. exp., about $300.

Management.—Not given.

BRISTOL, *Grafton Co.*—(Pop., 1,006; est., 1,200.) Engaged in manufacturing. Not incorp. Has sewers. No electric lights.

History.—Built in '86 by Bristol Aqueduct Co. Des. Engr., John H. Brown, Bristol. Contrs., Goodhue & Birnie, Springfield, Mass.

Water Supply.—Newfound lake, at point above dam, by gravity. Area of lake 9 sq. miles.

Dam.—At outlet of lake; owned by Bristol Water-Power Co.; of timber and stone, 60 ft. long on crest, with plank spillway, controlled by gates, 30 ft. from end. Raises water in lake about 7 ft.

Distribution.—*Mains*, cem., 5 miles. *Services*, rustless i. *Taps*, 103. *Meters*, none. *Hydrants*, kind not given, 32.

Consumption, not given. *Pressure*, 65 lbs.

Financial.—Cost, $22,230. Stock, $22,000. Debt, none. Ann. op. exp., about $200, including taxes. Ann. rev.: consumers, $1,123; city, $900. Hydrant rental, 30.

Management.—Prest. Benj. F. Perkins. Treas. and Genl. Man., Geo. M. Cavis. Supt. and Secy., John H. Brown.

CLAREMONT, *Sullivan Co.* (Pop., 4,704; est., 6,000.) On Connecticut river. Engaged in manufacturing. Incorp. a town. No sewers. Has electric lights.

History.—Built in '87-8 by Claremont Water-works Co. Engrs. & Contrs., N. W. Ellis & Co., Manchester. Town has right to purchase the works by appraisal within 5 years.

Water Supply.—Two brooks, by gravity.

Reservoirs.—Cap., 28,000,000 galls.; three with cap., of 2,750,000, 3,250,000 and 22,000,000 galls., respectively; latter is a storage reservoir, and was finished Nov., '88.

Distribution.—*Mains*, cem., 9 miles. *Services*, w. i. and cem. Pipe from New Haven (Conn.) Patent Water Pipe Co. *Taps*, 208. *Meters*, 16. *Hydrants*, Coffin, 42. *Valves*, Coffin.

Pressure: Ordinary and fire, 65 to 104 lbs.

Financial.—Cost, withheld, est., $90,000. Cap. stock, debt, int., and ann op. exp., withheld. Ann. rev., consumers, $3,000; city, $1,400. Hydrant rental, $35.

Management.—Prest., Chas. H. Bartlett. Secy., Edwin H. Carpenter. Treas., Jas. A. Weston, Manchester. Supts., Rand & Rice.

CONCORD, WEST CONCORD and PENACOOK, *Merrimack Co.* (Pop.: Concord, 13,843; est., not given. West Concord, not given. Penacook, est., 2,000.) Concord on both sides Merrimack river; trade and manufacturing center.

Settled in 1725; incorp. a city in '53. West Concord, adjoining village. Penacook, 6 miles from Concord. Engaged in manufacturing. Concord has sewers and electric lights.

History.—Built in '72-'3 by city of Concord, and extended to West Concord and Penacook in '87. Engr. of original works, Jos. A. Weston.

Water Supply.—Penacook lake, by gravity. Lake formerly known as Long pond; 2.84 miles northwest of center of city; from 37 to 152 ft. above various parts of it, being 122 ft. above main street, opposite State-house; area, 300 acres; original drainage area, 3 miles; increased 200 acres by building dam on outlet of lake, 2,000 ft. below its original head. The soil is sandy, underlaid with granite.

The water of the lake is shared by the city with mill below; supply limited to 365,000,000 galls. a year. Water measured by 3 6-in Gem meters placed in supply mains at point 200 ft. below the dam. Meters are inclosed in a stone chamber 10x16x8 ft., covered with earth.

Dam.—Of earth, with masonry heart-wall; 280 ft. long on crest, 110 on bottom, 20 ft. high, 20 ft. wide on top and 100 at bottom. Crest is 185 ft. above low-water in Merrimack river. Slopes are 2 to 1, inner being paved with quarried stone, pointed with cem. mortar, and outer soiled and seeded. Top is used as a driveway. *Heart-wall:* granite in cem. mortar, 3½ ft. thick at bottom, 2 at top; carried down 3 ft. below bottom of dam and within 2 ft. of top. *Overflow:* 40 ft. wide, with bottom 4 ft. below top of dam; 300 ft. from north end of dam; lined with masonry. *Gate-houses:* that at foot of upper slope is of granite masonry, 13 ft. sq. inside at bottom, tapering to 10 ft. sq. at top. A bridge connects it with top of dam. Gate-house below dam is of brick, 8 ft. sq. Des. Engr., Jas. A. Weston. Const. Engr., Chas. C. Lund. Cost $19,523. *Discharge-pipes:* three c. i.; two 16-and a 24-in.; former are supply mains, and are 3½ ft. below large pipe which conveys water for manufacturing purposes.

Conduit.—In two sections. First, brick, elliptical, 24x30 ins., extending into lake 1,950 ft. Second, 14-in. w. i. and cem., 3½ miles long, leading from lower gate-house to city; has gates at each end.

Distribution.—*Mains*, w. i. and cem., 42⅛ miles. *Services*, w. i. and cem., connected with tin-lined lead; original pipe from and laid by American Water-Works & Gas Pipe Co., now Ferris & Halladay, Jersey City, N. J. *Taps*, 1,227. *Meters*, 30. *Hydrants*, Mathews, Chapman, 170. *Valves*, Ludlow, Chapman. *Pressure-recording gauge*, Edson. *Close of '72*: Mains, 13½ miles. *Hydrants*, 60. *Close of '80*: Hydrants, 96.

Consumption, not given. *Pressure*, 46 lbs.

Financial.—Cost, $487,798. Debt, $435,000: $350,000 at 6, $85,000 at 5. Ann. op exp., $3,172. Ann. rev.: consumers, $32,081; city, $6,360. Hydrant rental, $40. Cost in '73, $285,778. Do., '80, about $350,000. Rev., '74, $4,431. Do., '80, $22,452.

Management.—Six Comrs. Prest., Jno. Kimball. Secy., Wm. M. Chase. Supt., V. C. Hastings.

DOVER, *Strafford Co.* (Pop., 11,687; est., 14,387.) On Cocheco river, 12 miles from Portsmouth. River falls 32 ft. at this point. Engaged in general trade and manufacturing. Settled in 1823, incorp. a city in '55. Partially sewered. Has electric lights.

History.—Three Co.'s furnished city with water until recently: Dover Landing Aqueduct Co., organized in '26; Cocheco Aqueduct Association, organized in '32; Dover Aqueduct Co., date of organization not given. In '88 the city purchased works of the aqueduct companies for about $100,000, and in '88-9 built new works. Engr., Percy M. Blake, Hyde Park, Mass.

Descriptions of the old works are given in *Engineering News*, Vol X., p. 423, and Vol. XIX., p. 391. In '87 distribution of the three systems combined was: *Mains*, 20 miles. *Meters*, 25. *Hydrants*, 17. In the same year the combined revenues were about $17,000.

Water Supply.—Springs gathered in two wells, reinforced by Willard pond, pumping to reservoir.

Pumping Machinery.—Dy. cap., not given; Blake. *Boilers:* two Whittier.

Reservoir.—Cap., 2,000,000 galls; area of water surface, 27,172 sq. ft.; bottom, 17,672 sq. ft.; 150 ft. in diam. at bottom, 186 at high water line, and 201 at inner edge top of embankment; 19 ft. deep in centre, 17 at foot of inner slope. Water is 14 ft. deep at centre, and 12 at foot of inner slope. Embankment carried 5 ft. above high water; 15 ft. wide on top. Inner slope, 1½ to 1. Bottom of concrete. High water 284 ft. above mean low tide level, and 163.38 ft. above engine-room floor. Contr., Danl. Dacey.

Distribution.—(July 29, '89.) *Mains*, 16 to 4 in., c. i., 25 miles. *Services*, w. i. and cem. Pipe and specials from R. D. Wood & Co, Philadelphia, Pa.; and trenching and pipe-laying done by Danl. Dacey and Hiram F. Snow. *Taps*, 1,600. *Meters*, Crown, Ball & Fitts, Hersey, Worthington, 60. *Hydrants*, Ludlow, 143. *Valves*, Eddy.

Consumption, not determined. *Pressure*: Ordinary and fire, 65 to 115 lbs.

Financial.—Cost (Jan. 1, '89),$264.777, of which $106,978 was paid for old aqueducts and land damages. Cost of complete works, about $350,000. Debt, about $350,000. Int., 4½%. Hydrant rental, $30.

Management.—Three Comrs.: Prest., Jos. W. Cate, Clerk, Chas. A. Fairbanks; and Arthur P. Whittemore. City Treas., Isaac F. Abbott, Supt., Wm. D. Taylor.

DREWSVILLE, *Cheshire Co.* (Pop., est, 90.) Four miles from Bellows Falls.

History.—Supplied by Drewsville Water Co., organized in 1804, and consisting of 10 shareholders.

General Description.—Supply is from spring, by gravity through ½ mile of bored logs. Some of the logs laid in 1804 are still in use, although most of them were relaid in '76. Water conveyed to covered wooden box 2 x 3 ft., x 2 ft. deep. In this box an auger hole is bored for each share of stock and from these holes water is piped to the houses, which are built on four sides of a common. The expense of maintenance is divided equally among the shareholders, but only item of importance recorded was in '76, when $282.91 was spent in relaying logs and putting new covering over wooden box serving as reservoir.

EXETER, *Rockingham Co.* (Pop. of town, 3,669; est., 4,000.) On Exeter river. Engaged in cotton and other manufacturing. Incorp. Partly sewered. Has electric lights.

History.—Built in '86-7 by Exeter Water Co., under perpetual charter. Engrs. and Contrs., Wheeler & Parks, 89 State St., Boston, Mass.

Water Supply.—Filter well and Wheelwright brook, pumping to stand-pipe.

Filter-Well.—Is 40 ft. in diam. and 25 ft. deep.

Storage Reservoir.—No data.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two 1,000,000 Worthington. *Boilers:* two return tubular; from E. Hodge & Co., E. Boston, Mass.

Stand-Pipe.—Cap., 220,000 galls.; 25 x 60 ft.; from E. Hodge & Co., East Boston, Mass.

Distribution.—*Mains*, c. i., 11½ miles. *Services*, ¾-in. enam. w. i. Pipe from R. D. Wood & Co, Philadelphia, Pa.; specials from R. D. Wood & Co., and Builder's Iron Foundry, Providence, R. I.; trenching and pipe-laying done by Ferris & Halladay, Jersey City, N. J. *Taps*, 330. *Meters*, Crown, 9. *Hydrants*, Coffin, 51.

Consumption, 60,000 galls. *Pressure*, av., 55 lbs.

Financial.—Cost, $150,000. Cap. stock, $90,000. Bonded debt, $50,000. Int., 5%. Ann. op. exp., $2,600. Int., $2,600. Ann. rev.: consumers, $4,500; city, $2,040. Hydrant rental, $40; 20-years contract.

Management.—Prest., E. G. Eastman. Secy., A. O. Fuller. Treas., Elbert. Wheeler, 21 Washington St., Boston, Mass. Supt., Chas. H. Johnson.

FARMINGTON, *Strafford Co.* (Pop. 3,040; est., 3,040.) On Cocheco river Has extensive boot and shoe manufactures. Incorp. a town in 1798.

History.—Built by city in '71.

Water Supply.—Springs, pumping to reservoir.

Pumping Machinery.—Dy. cap., not given; Knowles. *Boiler:* upright tubular.

Reservoir.—No data.

Distribution.—*Mains*, 8 to 4-in w. i. and cem., c. i., 1½ miles. *Services*, w. i. *Taps*, about 100. *Meters*, about 5. *Hydrants*, Caris Patent, 22.

Consumption, not given. *Pressure:* Ordinary and fire, 40 lbs.

Financial.—Cost, not given, est., $20,000. Debt (in '88), $8,379. Int., 4%. Ann. op. exp, $500. Ann. rev.: consumers (in '87) $1,100.

Management.—Chf. Engr., Wm. F. Thayer.

NOTE.—All requests for data were ignored in '89, but above is substantially correct.

GORHAM, *Coos Co.* (Pop., 1,383; est., 1,600.) On Androscoggin river, in mountainous country. Settled in 1800, incorp. a village in '36. No sewers or electric lights.

History.—Built in '73 by Alpine Aqueduct Co. Works designed and constructed by Co.

Water Supply.—Springs, by gravity to and from reservoir.

Reservoir.—Cap., 6,500 galls. At elevation of 130 ft. above village; brick and cem., 12 × 16 ft., 4½ ft. deep.

Distribution.—*Mains*, c. i., 3 miles; originally bored pine logs. *Services*, galv. i. *Taps*, 225. *Meters*, none. *Hydrants*, Mathews, 11. At close of '80 there were 1½ miles of mains, 125 taps, no meters or hydrants.

Consumption, 27,000 galls. *Pressure*, 56 lbs.

Financial.—Cost, $22,208. Cap. stock, $29,000. No debt. Ann. op. exp., $375. Ann. rev.: consumers, $2,687; city, $165. Hydrant rental, $15. Cost, close of '80, $7,000. Rev., '80, $1,000.

Management.—Prest., Warren Noyes. Secy. and Treas., Thos. E. Fisk.

GREAT FALLS, *Strafford Co.* (Pop., 5,586; est., 6,000.) On Salmon Falls river. One of the largest cotton and woolen manufacturing towns in the State. Sewers projected for '90. Has electric lights.

History.—Built by Great Falls Manufacturing Co., date not given. In '89 the Great Falls Water Co. was organized, management being same as of old Co., and works were extended.

Water Supply.—River, direct pumping, and pumping to reservoir.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Deane dup., water-power.

Reservoir.—Cap., 1,500,000 galls.

Distribution.—*Mains*, tarred c. i., 4 miles. *Services*, lead. *Taps*, 300. *Meters*, but few. *Hydrants*, Chapman, 50.

Consumption, 300,000 galls. *Pressure:* Ordinary and fire, 65 lbs. at pump.

Financial.—Cost, $125,000. (Probably includes cost of extensions made in '89.) Debt, none. Ann. op. exp., withheld, est., $3,000. Ann. rev.: consumers, withheld, est., $6,000; city, $1,666. Hydrant rental, $33.33

Management.—Treas., J. Howard Nichols, Boston, Mass. Supt., H. S. Chase.

HANOVER, *Grafton Co.* (Pop., 800; est., 1,000.) On plain ½ mile east of, and from 125 to 175 above, Connecticut river. Divided in two parts by rocky ridge about 100 ft. high. Settled under charter granted in 1761. Has no electric lights or sewers.

History.—Built in '20 by Hanover Aqueduct Co.

Water Supply.—Eight springs collected in 5 wells, by gravity. Springs located on wooded hillside. Wells are from 4 to 6 ft. in diam., 8 to 12 ft. deep; lowest being 60 ft. above village.

Conduit.—Dy. cap., 12,600 galls.; from wells to village; from '21 to '80, of 1½-in. lead pipe; replaced in '80 by 2-in. lead pipe. The first 1,000 ft. descends 60 ft., then crosses brook in wooden box laid on granite bed of stream and weighted with boulders. Conduit is seldom submerged, but though temperature is sometimes 25° below zero, water in the pipe has never frozen. Near village conduit passes through a hollow under 110 ft. head. Weight of present pipe: under 60-ft. head, 7 lbs. per ft.; 60 to 80-ft. head, 8 lbs; 80 to 110-ft. head, 9 lbs.

Distribution.—*Mains*, lead, 2 miles. *Services*, lead. *Taps*, about 150. *Meters*, none. *Hydrants*, none. Water is delivered to consumers through copper gauge butts perforated with a hole the size of an ordinary needle. One of these is intended to deliver 40 galls. per day.

Consumption, 10,000 galls. *Pressure:* 50 to 100 ft. head.

Financial.—Cost, $12,000. Cap. stock, $10,000. No debt. Ann. op. exp., $300. Ann. rev.: consumers, $1,200 from about 150 families; city, none. Est. cost at close of '80, $12,000; of '70, $5,000.

Management.—Prest. and Supt., F. Chase. Secy., E. R. Ruggles.

HILLSBOROUGH BRIDGE, *Hillsborough Co.* (Pop., 2,000; est., 2,000.) Engaged in manufacturing, lumbering and general trade. Is incorp. Has no sewers or electric lights.

History.—Built in '87 by Hillsborough Water Co. Engrs. and Contrs., Goodhue & Birnie, Springfield, Mass.

Water Supply.—Loon pond, area 600 acres, by gravity.

Distribution.—*Mains*, w. i. and cem., 5 miles. *Services*, not given. *Taps*, 139. *Meters*, none. *Hydrants*, kind not given.

Consumption, unknown. *Pressure*, not given.

Financial.—Cost, $50,000. Debt, $25,000. Int., 5%. Ann. op. exp., withheld, est., $1,000. Ann. rev: consumers, withheld, est., $1,500; city, $1,000.

Management.—Prest., Jno. C. Campbell. Secy. and Supt., Saml. W. Holman. Treas., Wm. Birnie, Springfield, Mass.

HINSDALE, *Cheshire Co.* (Pop., 1,868; est., 2,100.) On Ashuelot river. Engaged in manufacturing woolen goods, paper, hardware and wooden ware.

History.—Built in '84 by village for fire protection. **Water Supply.**—Canal, by means of 4 force pumps in mills. **Distribution.**—*Mains*, 4-in. iron, 1¾ miles. *Hydrants*, Chapman, 22. **Management.**—Chf. Engr. Fire Dept., N. H. Bardwell. Town Clerk, E. E. Hall.

KEENE, *Cheshire Co.* (Pop., 6784; est. 8,000.) On Ashuelot river. Engaged in manufacturing. Settled in 1753; incorp. a city in '74. Has sewers and electric lights.

History.—Built in '69 by town, and enlarged in '88. Engrs., Phineas Ball and John Humphrey.

Water Supply.—Two lakes, by gravity. Lakes have a drainage area of about 1,900 acres.

Dams.—Three. One of earth, 300 ft. long, 8 ft. high; one of earth, 150 ft. long, 20 ft. high, with masonry heart-wall, and with inner slope paved with stone: one 225 ft. long, 22 ft. high. In '89 it was proposed to rebuild the Echo lake dam. First cost of dams, $20,000.

Conduits.—Two, being an independent main from each lake. In '80 one conduit was thus described, 500 ft. of 16-, 500 ft. of 14- and 2½ miles of 12-in. pipe, mostly cem. Av. head, 150 ft.

Distribution.—*Mains*, w. i. and cem. c. i., 32 miles. *Services*, w. i. *Taps*, 1,226. *Meters*, none. *Hydrants*, Worcester and Humphrey, flush, and Mathews, post, 144. *Valves*, Ludlow, Eddy, Chapman.

Consumption, 1,500,000 galls. *Pressure:* 55 to 70 lbs.

Financial.—Cost, $223,501. Debt, $133,500: $61,500 at 6, $35,000 at 5, $37,000 at 3½%. Sinking fund, $18,457. Ann. op. exp., $1,600. Ann. rev.: consumers, $13,200. Cost, close of '80, $162,700.

Management.—Three Comrs. Supt., P. F. Babbidge.

LACONIA and LAKE VILLAGE, *Belknap Co.* (Pop.: Laconia, est. 6,000; Lake Village, est., 3,000.) Villages close together, at outlet of Lake Winnipiseogee; both engaged in manufacturing. Incorp. No sewers. Have electric lights.

History.—Built in '85 by Laconia and Lake Village Water-Works Co. Engrs. and Contrs., N. W. Ellis & Co., Manchester.

Water Supply.—Lake Winnipiseogee, pumping to reservoir.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; Blake, 1,000,000 dup., and a 2,000,000; latter added in '88.

Reservoir.—Cap., 2,750,000 galls.

Distribution.—*Mains*, 12 to 4-in. w. i. and cem., w. i., 13.8 miles. *Services*, w. i. and cem. *Taps*, 653. *Meters*, 390; 381 added in '88. *Hydrants*, Coffin, 79. *Valves*, Coffin.

Consumption, 360,982 galls. *Pressure*, 85 lbs.

Financial.—Cost, $102,269. Cap. stock, $60,000. Bonded debt, $40,000. Int., av., 5%. Sinking fund, none. Ann. op. exp., $3,320. Ann. rev.: consumers, $6,554; city, $2,710. Hydrant rental, $30.

Management.—Prest., Jno. C. Moulton, Laconia. Secy. and Treas., Edmund Little, Laconia. Supt., F. P. Webster.

LAKE VILLAGE, *Belknap Co.* See Laconia and Lake Village.

LANCASTER, *Coos Co.* (Pop., est., 1,500.) On Israel's river, near Connecticut river. Engaged somewhat in manufacturing.

LANCASTER AQUEDUCT CO.'S WORKS.

History.—Built for domestic use, date not given.

Water Supply.—Springs, 3 miles distant, by gravity. Springs are 100 ft. above level of street.

Distribution.—*Mains*, c. i., 6 miles. *Services*, iron. *Taps*, 100. *Meters and Hydrants*, none.

Consumption and Pressure, not given.

Financial.—Cost, withheld, est., $25,000. Debt and int., withheld. Ann. op. exp., withheld, est., $300. Ann. rev.: consumers (in '87), $1,100.

Management.—Treas., C. E. Allen.

VILLAGE WORKS.

General Description.—Built by fire wards, date not given. A force-pump driven by water-wheel in mill forces water through 600 ft. of pipe. *Hydrants*, 6. Address W. Mashall.

LEBANON, *Grafton Co.* (Pop., est., 3,000.) Engaged somewhat in manufacturing. Not incorp. No sewers or electric lights.

History.—Built in '87-8 by village: turned over to village by construction Co., Apr., '89. Engr., W. H. Lang. Contrs., W. H. Lang, Goodhue & Co., Burlington, Vt., who furnished all material.

Water Supply.—Mascoma River, pumping to reservoir.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Lang triplex plunger.

Reservoir.—Cap., 1,000,000 galls.

Distribution.—*Mains*, c. i., 5.65 miles. *Services*, cnam, I. *Taps*, 143; 196. July 8, '89. *Meters*, none. *Hydrants*, kind not given, 54.

Consumption, 229,000 galls. *Pressure:* Ordinary and fire, 115 lbs.

Financial.—Cost, 45,185. Bonded debt, $40,000. Int., 4½ %.

Management.—Com. of three. Supt., H. P. Goodrich.

LISBON, *Grafton Co.* (Pop., 772; est. 1,200.) Engaged in manufacturing. Incorp. a town. No sewers or electric lights.

History.—Built in '86 by Lisbon Water-Works Co. Des. Engr., N. W. Ellis. Const. Engr., Jno. P. Young, Manchester. Contrs., N. W. Ellis & Co: Sub-contrs. Inman Bros., New York City.

Water Supply.—Pearl Lake, by gravity.

Distribution.—*Mains*, 8 to 4-in. w. i. and cem., 4 miles. *Services*, w. i. *Taps*, 76. *Meters*, none. *Hydrants*, Coffin, 31. *Valves*, Coffin.

Consumption, unknown. *Pressure:* Ordinary and fire, 100 lbs.

Financial.—Cost (in '87), $25,000. Debt and int., not given. Ann. op. exp., $300. Ann. rev.: consumers, $825; city, $775. Hydrant rental, $25.

Management.—Supt., L. C. Payne.

LITTLETON, *Grafton Co.* (Pop. of town, 2,936; est., 4,500.) Summer resort. Has manufactories. Has electric lights.

History.—Built (date not given, but prior to '88) by Littleton Water & Electric Light Co. Engr., N. W. Ellis, deceased. Contrs., N. W. Ellis & Co., Manchester.

Water Supply.—Source not given, by gravity and pumping to reservoir.

Pumping Machinery.—Dy. cap., not given; Worthington.

Reservoir.—No data.

Distribution.—All withheld. Est.: *Mains*, 7 miles. *Taps*, 400. *Hydrants*, 40. *Consumption* and *Pressure*, not given.

Financial.—Cost, $120,000. Bonded debt, $75,000. Int., 6%. Ann. op. exp., withheld, est., $1,500. Ann. rev.: total, $10,000.

Management.—Prest. and Supt., B. H. Corning. Secy. and Treas., C. B. Ludwig, 72 Broadway, New York City.

MANCHESTER, *Hillsborough, Co.* (Pop., 32,630; est., 41,000.) On Merrimack river, there being a fall of 55 ft. in the river at this point. Largely engaged in manufacturing cotton and woolen goods, locomotives and fire engines. Settled in 1722. Incorp. as town of Derryfield in 1751; name changed to Manchester in 1810; incorp. a city in '46. Has sewers and electric lights.

History.—Built by city in '72-4 when pop. was 25,000. Engr., Jno. T. Fanning, Minneapolis, Minn. Built mostly by day's work, under direction of city. A part of the distributing system was put in by Ferris & Halladay, Jersey City, N. J.

Water Supply.—Lake Massabesic, pumping to reservoir.

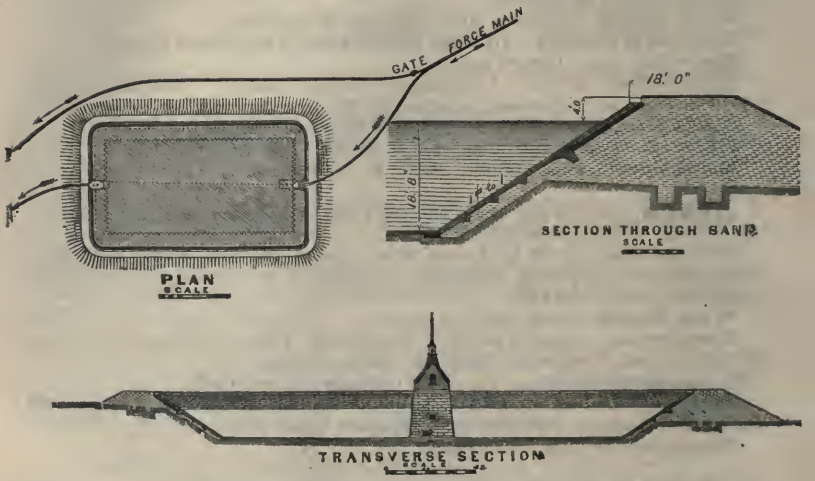
Dam.—At outlet of lake. Of earth, with heart-wall of grouted rubble masonry. Overfall of dam, stone masonry, 100 ft. long, 24 ft. high above apron. Has stepped face to break falling water.

Penstock.—A canal 15 ft. below overfall, and 1,470 ft. long, conveys water to penstock 6 ft. in diam. and 600 ft. long, leading to wheels. Penstock made of staves of Georgia pine, hooped with iron, and its lower part sustains a pressure of 40 ft. head

Pumping Machinery.—Dy. cap., 11,000,000 galls.; one 6,000,000 Wood water-power, with two pairs of buckets and 1 plungers, having 16-in. cylinders, 11¼-in. plungers, with 40-in. stroke; also Davidson 5,000,000, with two 24-in. horizontal plungers. *Water-wheels:* The Wood pumps were originally driven by two 36-in. Jonval turbines working under 45-ft. head, and lifting water 113 ft. to reservoir. In '87 the Jonval turbines were replaced by two Risdon water-wheels, 175 H. P. each.

Reservoir-Conduit.—Cem. lined w. i., with c. i. hubs and lead joints, 6,752 ft. of 20-in. pipe.

Reservoir.—Cap., 15,000,000 galls.; 275 x 475 ft., x 23 ft. deep; surface, 152 ft. above city hall, 188 above depot. Inner slopes built with concrete. See accompanying plan and sections.



Distributing Reservoir, Manchester, N. H.

Distribution.—*Mains*, 20 to 4-in. c. i., w. i., and cem., 151½ miles; originally w and cem., but since '76 of c. i. In the four years, '77 to '80, there were 745 leaks in the cem. lined w. i., and but 85 in the c. i. pipe. In '77 a leak was found where a 12-in. main crossed a river. It was in the spigot end of a length, close to the bell, 5 ins. long by ⅛ in. wide. While repairing it, a sand and water jet wore out a piece of iron 8 in. sq. and 1 in. thick in 48 hours. *Services*, enam. i.; rubber-coated iron has been tried. *Taps*, 3,087. *Meters*, 812. *Hydrants*, Coffin and Puttee, 426. *Gates*, Coffin and Ludlow. *At close of '80 there were:* Mains, 32½ miles. Taps, 1,807. Meters, 280. Hydrants, 307.

Consumption, 1,900,000 galls. *Pressure*, Ordinary and fire, 62 lbs.

Financial.—Cost, 932,000. Debt, $600,000; $500,000 at 6 and $100,000 at 4%. Ann. op. exp., $15,000. Ann. rev.: consumers, $65,000; city, $20,000.

Management.—Five Comrs. and Mayor. Prest., Alpheus Gay. Clerk, Jas. A. Weston. Registrar, Arthur E. Stearns. Supt., Chas. K. Walker.

MILFORD, *Hillsborough Co.* (Pop., 2,398; est., 3,000.) Summer resort and manufacturing village. In '89, 2,040 ft. of sewers were projected. No electric lights.

VILLAGE WORKS.

General Description.—Built in '82 for fire protection. Short mains and 6 hydrants.

MILFORD WATER-WORKS CO.

History.—Built in '89. Town has right to buy works within one year at cost, int. and 5% bonus, or any time afterward, within 20 years, at actual value.

Water Supply.—Clark's brook, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 1,000,000 galls.

Stand-Pipe.—Cap., 250,000 galls.; 170 ft. above public square.

Distribution.—*Mains*, 10 to 6-in., 6 miles.

Management.—Prest., Robt. Blakle. Secy. and Treas., Jno. T. Langford Mason Building, Boston, Mass. Supt., C. B Burney.

NOTE.—Above subject to correction, as latest report was made when construction began.

NASHUA, *Hillsborough Co.* (Pop. 13,397; est., 18,000). On Nashua river near its junction with Merrimack river. A manufacturing city. Incorp. in '53. Has sewers and electric lights.

History.—Built in '55 by Pennichuck Water-Works Co.

Water Supply.—Pennichuck brook, 1¼ miles from city, by direct pumping and pumping to reservoir. Brook flows from Long pond, west of city, with rapid descent to the Merrimack river, furnishing 5 water-powers, all owned by Co., with dams at 3. No manufacturing is allowed on stream. Available drainage area, about 30 sq. m.

Dams.—Three. One of wood and stone, 15 ft. fall; one of stone, 17 ft. fall; other not described.

Pumping Machinery.—Dy. cap., 7,500,000 galls.; two Lang water-power, combined cap., 4,500,000, and 3,000,000 Worthington steam. Steam pump used only about three months of year. The Lang pumps have 12-in. plunger and barrels, 28-in. stroke, 24 strokes per minute. Engine has 14 x 36-in. cylinders, 60 strokes per minute. *Water-wheels:* Jonval, at lower dam, 15 ft. head, 94 revolutions per minute; two Swain, at middle dam, 24 ft. head, 200 revolutions per minute: 8 galls. lifts 1 gall. to reservoir. *Boiler:* horizontal, tubular.

Force Main.—Is 5,200 ft. long, with 132 ft. head on pump.

Reservoir.—Cap., 1,500,000 galls.

Distribution.—*Mains*, c. i., 35 miles. *Services*, lead and galv. i. *Taps*, 2,500. *Meters*, 50. *Hydrants*, Chapman, 90. *Valves*, Chapman.

Consumption, 2,000,000 galls. *Pressure:* Ordinary, 50 lbs. Fire, 90 lbs.

Financial.—Cost, "unknown," est., $280,000. Cap. stock, $250,000. Debt, none. Ann. op. exp., withheld, est., $7,000. Ann. rev.: consumers, withheld, est., $20,000; city, $3,780. Hydrant rental, $42. Original cost, $60,000.

Management.—Prest., Edw. Spalding. Treas., Harry M. Hobson. Supt. Horace G. Holden.

NORTH CONWAY, *Carroll Co.* (Pop., 553; est., 850). Incorp. a town. No sewers or electric lights.

History.—Built in '83 by North Conway Water Co. Labor done by Co.

Water Supply.—Artist's brook, by gravity.

Impounding Dam and Reservoir.—Cap., 2,000,000 galls.; 172 ft. above Main St. Dam of split stone in cement, 50 ft. long, 8 ft. high, 8 ft. wide at bottom and 4 ft. at top. Founded on ledge. *Spillway:* in center, 2 x 3 ft., controlled by gate. Built under direction of L. Pitman, Supt. Contrs., Whitaker & Lewis, No. Conway.

Conduit.—Length, 6,200 ft.; 50 ft. of 10, 800 of 8, and 5,350 ft. of 6-in. c. i. pipe.

Distribution.—*Mains*, 10 to 2-in. tarred c. i., 8 miles; from R. D. Wood & Co., Philadelphia, Pa. *Services*, ¾-in. tarred w. i. *Taps*, 98. *Meters*, none. *Hydrants*, Mathews, 6. *Valves*, Eddy.

Consumption, not given. *Pressure*, 90 lbs.

Financial.—Cost, $20,000. Cap. stock, $20,000. No debt. Ann. op. exp., withheld, est., $800. Ann. rev.: consumers, withheld, est., $2,000; city, none.

Management.—Prest., W. M. Pitman. Secy., Treas. and Supt., Lycurgus Pitman.

NORTHFIELD, *Merrimack Co.* See Tilton and Northfield.

PENACOOK, *Merrimack Co.* See Concord.

PETERSBOROUCH, *Hillsborough Co.* (Pop., 2,206; est., 2,300.) On Contacook river. Engaged in manufacturing cotton and woolen goods and shoes.

General Description.—Three small pumps and 4 and 6-in. mains used in connection with 17 hydrants. Supt., Jno. M. Steele. A small fire protection system built by town, date not given.

PITTSFIELD, *Merrimack Co.* (Pop., 1,184; est., 2,000.)

History.—Built in '84 by Pittsfield Aqueduct Co. Des. Engrs., A. Whittemore, Jr., and S. J. Winslow. Const. Engr., N. W. Ellis, Manchester. Contrs., Connecticut Patent Water Pipe Co., New Haven, Conn.

Water Supply.—Berry Bond, by gravity to reservoir, and thence to village. Pond is 2¼ miles from, 400 ft. above, main street of village.

Reservoir.—Cap., 1,500,000 galls.; in ravine, below pond.

Distribution.—*Mains*, w. i. and cem., 7 miles. *Services*, w. i. *Taps*, 326. *Meters*, 1. *Hydrants*, Ludlow, 27. *Valves*, Bigelow.

Consumption, 200,000 galls. *Pressure*, 80 lbs.

Financial.—Cost, $33,000. Cap. stock, $40,000. No debt. Ann. op. exp., $500. Ann. rev.: consumers, $3,500; city, $945. Hydrant rental, $35, and exemption from taxation for 10 years.

Management.—Prest., R. L. French. Treas., Jno. A. Goss. Supt., S. J. Winslow.

PLYMOUTH, *Grafton Co.* (Pop., 1,719; est., 2,000.) On Pemigewasset river. Engaged in manufacturing. Not incorp. Has sewers. No electric lights.

History.—Built in '81 by Plymouth Aqueduct & Water Co. Des. Eng., Chas. Lund. Const. Engr., W. F. Langdon. Contrs., Goodhue & Birnie, Springfield, Mass.

Water Supply.—Springs, by gravity, water being collected in two small reservoirs.

Dams and Reservoirs.—Combined cap., 4,000,000 galls. *Old Dam and Reservoir:* cap., 1,000,000 galls.; area ⅛ acre. Dam of earth, about 100 ft. long, 18 ft. high, 6 ft. wide on top, with inner slope 1½ to 1, paved with cobble stone; outer slope, natural. *Discharge-pipe:* 8 ins. in diam. No spillway. Beneath center of dam trench was dug and filled with puddled clay. Water-level, 5 ft. below top. Built in '81. Cost, about $13,000. *New Reservoir:* Cap., 3,000,000 galls.; area, ⅔ acres. Dam, 127 ft. long and 23 ft. high. Main part of puddled clay and gravel. Lower face has natural slope, and from a point about ⅔ the horizontal distance from toe to top the bank is not puddled. Beneath upper half of dam there is 2 ft. of puddled clay. Upper side consists first of a perpendicular granite wall, 13 ft. high and 6 ft. thick, outer 2 ft. being split granite in cem., the inner 4 ft., rough, laid in puddled clay. From the top of this wall, at junction of rough and split granite, the puddled embankment is carried 5 ft. vertically and 11 ft. horizontally; from top of this slope a line of split granite, 2 ft. sq., extends across dam, its upper surface being at normal water line, 3 ft. below top of dam. Remaining distance slope is about 1 to 1. Main walls were to be built 4 ft. higher, in '89, and 2-ft. wall and top of dam, 2 ft., making water at dam 22 ft. deep. While being built top of the embankment was kept flooded with 3 to 4 ins. of water. *Discharge-pipe:* 6-in. Built in '85. Engr., W. F. Langdon. Supt. Contr., A. R. Smith. Cost, $6,000.

Distribution.—*Mains*, 8 to 4-in. w. i. and cem., 3½ miles. *Services*, tarred w. i. *Taps* (in '87), 130. *Meters*, 1. *Hydrants*, Perkins, 27.

Consumption, 50,000 galls. *Pressure*, 76 lbs.

Financial.—Cost, $10,000. Cap. stock, $20,000. Bonded debt, $20,000. Int., 5%. Ann. op. exp. $200. Ann. rev.: consumers, $1,600; city, $675. Hydrant rental, $25, fire wards keeping hydrants in repair.

Management.—Prest., Alvin Burleigh. Secy., Geo. Adams. Treas., Jno. Mason. Supt., W. F. Langdon.

PORTSMOUTH, *Rockingham Co.* (Pop., 9,690; est., 11,000.) On Piscataqua river. Engaged in manufacturing, ship-building and commerce, being only seaport town in the State. Has electric lights.

History.—Built in 1798 by Portsmouth Aqueduct Co., which was incorp. Dec. 19, 1797, as "The Proprietors of the Portsmouth Aqueduct."

Water Supply.—"Twenty bubbling springs," by gravity and pumping to reservoir for high service. Springs are on hills, 2 to 3 miles from town, at different localities.

Conduits.—From various springs to town. First two were 5-in. wood pipes, each 2½ miles long. In '68 w. i. and cem. pipe, 2 miles long, was laid to other spring, and in '75 a 10-in. wood pipe, about 3¾ miles long, was added.

Pumping Machinery.—No data.

Reservoir.—Cap., 500,000 galls; 70 x 100 ft., x 10 ft. deep; in two divisions, excavated in hillside. Upper side has masonry walls 1 ft. thick; lower, 5 ft. thick at bottom, 2 ft. at top; both walls slope.

Distribution.—*Mains*, length not given; originally wooden logs, being replaced with c. i. It is stated that the 2-in. bore of some of the original logs was found worn

to 3 ins. *Services*, wooden logs, c. i., lead. *Hydrants*, none; 14 small reservoirs or cisterns are kept filled for use in case of fire.

Consumption and *Pressure*, not given.

Financial.—All withheld. *Est.*: cost, $110,000. Ann. op. exp., $2,000. Ann. rev.: consumers, $15,000.

Management.—Prest., J. J. Pickering. Secy., Treas. and Supt., Jno. J. Ayers. City Clerk, Mercer Goodrich.

NOTE.—All inquiries sent in '89 ignored.

ROCHESTER, *Strafford Co.* (Pop., 4,683; est., 5,000.) Manufacturing town Not incorp. No sewers. Has electric lights.

History.—Built in '85 by Rochester Aqueduct and Water Co. Des. Engr. M. M. Tidd, Boston, Mass. Const. Engr., J. A. Farrington. In '89 Legislature passed an act enabling town to buy the works.

Water Supply.—Brook, 4 miles from town, by gravity through canal to reservoir and thence to town.

Reservoir and Dam.—Cap., not given; area, about 50 acres; depth, 28 ft. Dam across outlet was built by a Mr. Shannahan, Portland, Me.

Distribution.—*Mains*, c. i., 8 miles. *Services*, w. i. Pipe from A. H. McNeal, Burlington, N. J.; laid by Inman Bros., New York. *Taps*, 220. *Meters*, none. *Hydrants*, Coffin, 53. *Valves*, Coffin.

Consumption, unknown. *Pressure*: Ordinary and fire, 68 lbs.

Financial.—Cost, $96,000. Cap. stock, $100,000. No debt. Ann. op. exp., $2,400, including taxes. Ann. rev.: consumers, $3,500; city, $2,650. Hydrant rental, $50.

Management.—Prest., Frank Jones. Secy., T. D. Wentworth. Treas., Albert Wallace. Supt., Jno. Greenfield.

TILTON and NORTHFIELD, *Belknap and Merrimack Cos.* (Pop.: Tilton town, 1,282; village, est., 1,600. Northfield town, 918; village, est., 2,000.) Northfield village is in towns of Tilton and Northfield. Have manufactories. Incorp. Partially sewered. Have electric lights.

History.—Built in '88 by Tilton & Northfield Aqueduct Co., with S. J. Winslow agent for construction.

Water Supply.—Knowles lake and Forest pond, by gravity. Lake 300 ft. above village. Pond in Canterbury; drawn upon in '89.

Distribution.—*Mains*, material not given, 4 miles. *Services*, not given. *Taps*, 150. *Meters*, none. *Hydrants*, kind not given, 20.

Consumption and *Pressure*, not given.

Financial.—Cost, $36,000. Debt, $9,000. Int., 4%. Ann. op. exp., $500. Ann. rev.: consumers, withheld, est., $1,500; city, $600. Hydrant rental, $30.

Management.—Prest., Jno. J. Pillsbury. Secy., W. B. Fellows. Treas., S. B. Peabody. Supt., M. G. Keasor.

WEST CANAAN, *Grafton Co.* (Pop., est., 60.)

History.—Built in '86 by West Canaan Aqueduct Co., for domestic use.

Water Supply.—Spring, by gravity.

Distribution.—*Mains*, 1-in. w. i. and cem.

Financial.—Cost, $500; secured by cash subscriptions for shares.

Management.—Clerk and Agent, M. F. Colby.

WOLFBOROUGH, *Carroll Co.* (Pop., town, 2,222; est., 3,000.) On Lake Winnipiseogee, 40 miles from Concord. Summer resort. Has manufactories. Incorp. town. No electric lights or sewers.

History.—Construction began Oct., 1, '89, by town; then proposed to put in operation Jan. 1, '90. Des. Engr., J. A. Farmington, Portsmouth. Const. Engr., J. F. Springfield, Rochester.

Water Supply.—Beach pond, by gravity. Area of pond, 300 acres; 4 miles from town; 400 ft. above main street.

Reservoir.—Cap., 250,000 galls. Contr., F. R. Page, Malden, Mass.

Distribution.—*Mains*, 8-in. c. i., 9 miles. *Services*, ¾-in. rustless i. pipe from McNeal Iron & Foundry Co., Burlington, N. J.; specials from Gilchrist & Gorham, Boston, Mass.; trenching and pipe-laying by F. A. Snow, Providence, R. I. *Hydrants*, kind not given, 38.

Pressure, 100 lbs.

Financial.—Cost, about 45,000. Bonded debt, $40,000. Int., 4%.

Management.—Comrs.: Jno. L. Peavy, H. W. Furber, I. B. Manning. Report by C. F. Pipe; date, Nov. 26, '89.

WOODSVILLE, *Grafton Co.* (Pop., 402; est., 800.) Not incorp. No sewers or electric lights.

History—Built in '86, extended in '88, by Woodsville Aqueduct Co. Engr., W. H. Lang. Contrs. for all labor and material, W. H. Lang, Goodhue & Co., Burlington, Vt.

Water Supply.—Ammanoosuc river, direct pumping.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Lang.

Distribution.—*Mains*, iron, 4 miles. *Services*, iron. *Taps*, 141. *Meters*, none. *Hydrants*, kind not given, 19.

Consumption, 80,000 galls. *Pressure:* Ordinary, 70 lbs. Fire, 100 lbs., or more.

Financial.—Cost, $29,223. Cap. stock, bonded debt., int., not given. Sinking fund, $1,600. Ann. op. exp., $375. Ann. rev.: consumers, $2,200; city, $380. Hydrant rental, $20.

Management.—Prest., Ira Whitcher. Treas., Chester Abbott. Supt., Ezra B. Mann.

Water-Works Projected with fair Prospects of Construction.

BERLIN FALLS, *Coos Co.* (Pop., town, 1,144; est. pop. to be supplied, 10,000.) Has electric lights.

Proposed Works.—Berlin Aqueduct Co. to build in summer of '90, at est. cost of $50,000. Supply, two mountain brooks, by gravity. Engr., C. E. Jordan, Portland. Address W. C. Perkins or L. N. Clark; report by latter, dated Dec. 2, '89.

BOSCAWEN and PENACOOK, *Merrimack Co.* (Pop.: Boscawen, town, 381. Penacook, est., 2,000.) Penacook 6 miles from Concord. Manufactures cotton and woolen goods and furniture.

Proposed Works.—Boscawen & Penacook Water Co. incorp. in '89, organized with following officers: Prest., J. C. Pearson; Clerk, I. K. Gage. Supply from Great pond in Boscawen, by gravity. Est. cost, $100,000. No cap. for construction secured Oct. 26, '89, date of report; time of building works uncertain. Address I. K. Page, Boscawen, or Jno. Kimball, Concord. Report by J. C. Pearson.

CANAAN, *Grafton Co.* (Pop., est., 600.) Some manufactories.

Proposed Works.—Crystal Lake Water Co , incorp. in '89, not organized Oct. 16, '89. Supply, Crystal lake, by gravity; lake 1¼ miles from, 250 ft. above, village. Est. cost, $10,000. No cap. secured. Latest report, Feb. 28, '90, when prospects of building in '90 were slight. Report by C. O. Barney.

DERRY, *Rockingham Co.* (Pop., town, 2,140; est., 2,500.) One mile from Derry Depot, 12 from Manchester. Has good water-power and two shoe-shops.

Proposed Works.—Derry Water Co. incorp. in '89; organized latter part of year with W. S. Pillsbury, Prest.; F. J. Shepherd, Treas.: Fred R. Felch, Clerk. No further data.

FRANKLIN, *Merrimack Co.* (Pop., not given.)

Proposed Works.—An attempt to build works was made and failed in '88. Summer of '89 legislative authority was obtained; Feb., '90, unofficially reported that works would be built coming season.

HAMPTON, *Rockingham Co.* (Pop., town, 1,184.)

Proposed Works.—Hampton Water-Works Co. incorp. in '89. No works in operation Jan. 23, '90.

NEWPORT, *Sullivan Co.* (Pop., 2,612.) On Sugar River. Engaged in manufacturing.

Present Supply.—Two small aqueduct lines, owned by S. H. Edes and M. S. Jackson; river and 3 small reservoirs for fire protection. No further data can be obtained.

Proposed Works.—Charter granted in '87 to Dexter Richard and Frederick W. Lewis. It is proposed to take water from Sunapee lake, by gravity, to reservoir near village. Pipe line, 6 miles long, was surveyed. Est. cost, $50,000. July 25, '89, above parties were trying to induce town to exempt works, if built, from taxation. Town Clerk, E. C. Hitchcock.

NORTHWOOD NARROWS, *Rockingham Co.* (Pop., est., 500.)

Proposed Works.—Surveys made in '89 for gravity pipe line from Jenness lake to village. Area of lake, 500 acres; 1½ miles from village. Est. cost, $10,000. No cap. secured. Reports by O. M. James, who made surveys; dates, Nov. 30, '89, Mar. 10, '90.

THE WEIRS, *Belknap* Co. (Pop.: est., permanent, 100; summer, 1,000 to 10,000.) On Meredith bay, Lake Winnipiseogee. Summer resort.

Present Supply.—Spring supplying small section, and wells.

Proposed Works.—The Weirs Water-Works Co., incorp. in '89, propose to build in '90. Supply, Lake Winnipiseogee, pumping to reservoir. Est. cost, $20,000. June 26, '89, cap. secured by subscription for stock, provided town of Laconia would rent hydrants. Latter part of July, '89, report stated construction postponed till '90. Reports by Irving A. Watson, Concord; dates, as above. G. P. Conn, Concord, also interested.

VERMONT.

Water-Works Completed or in Process of Construction.

BARRE, *Washington Co.* (Pop., 2,660; est., 5,000.) Has large granite quarries. Incorp. a village. Has sewers and electric lights.

History.—Built in '88 by Barre Water Co. Contrs., Goodhue & Birnie, Springfield, Mass.

Water Supply.—Stevens branch of Winooski river, by gravity.

Distribution.—*Mains*, iron, 10 miles. *Services*, not given. *Taps*, 100. *Meters*, none. *Hydrants*, kind not given, 62. *Valves*, Chapman.

Consumption, unknown. *Pressure*, 150 lbs.

Financial.—Cost, about $75,000. Cap. stock, bonded debt, int., withheld. Ann. op. exp., withheld, est., $1,000. Ann. rev.: consumers, withheld, est., $2,500; city, $1,800. Hydrant rental, about $30.

Management.—Prest., J. Henry Jackson. Secy., Edw. W. Bisbee. Treas., Thos. D. Birnie. Supt., Nelson D. Phelps.

BARTON, *Orleans Co.* (Pop., 742; est., 1,000.) In agricultural district. Has water-power.

History.—Built in '89 by village. Engr., Joel Foster, Montpelier.

Water Supply.—Mountain brook, by gravity. Source about 300 ft. above, 6,000 ft. from, village.

Distribution.—*Mains*, 3½ miles. *Hydrants*, 22.

Financial.—Cost, about $18,000. Bonded debt, $16,000.

Management.—Three Comrs.: T. W. Drew, E. F. Dutton, Geo. H. Blake. Report by latter; date, July 24, '89. Report from a resident, Oct. 20, '89, said pipe was nearly all laid.

BARTON LANDING, *Orleans Co.* (Pop., 378; est., 1,000.)

General Description.—Built in '84, extended in '86, by town. Supt., C. E. Joslyn. No report can be obtained in time for insertion.

BELLOWS FALLS, *Windham Co.* (Pop., 2,229; est., 3,000.) On Connecticut river. Has good water-power; engaged in paper and other manufacturing. Incorp. a village in '33. Has electric lights.

History.—Built by village in '48. Engr., unknown.

Water Supply.—Lake Minard, 300 ft. above village, by gravity. Lake has area of 75 acres, drainage area of ½ sq. m., est. av. depth of 12 to 15 ft., and is fed by springs.

Dam.—Earth, 225 ft. long, 3 ft. high, formed by trenching, planking and filling. Cost, $1,000.

Conduit.—Of 8 in. c. i., 9,440 ft. long, taking water 7 ft. below surface of lake.

Distribution.—*Mains*, c. i., 7 miles. *Services*, lead and w. i. *Families supplied*, 600. *Meters*, 6. *Hydrants*, R. D. Wood & Co.'s, 50. *Valves*, Ludlow.

Consumption, not given. *Pressure:* Ordinary, 127 lbs. Fire, 127 lbs.

Financial.—Cost, $60,000. Debt, $39,100. Int., one half at 5, one half, 6%. Ann. op. exp., $750. Ann. rev.: consumers, $6,000; city, $1,350.

Management.—Comrs., F. A. George, W. A. Howard, E. S. Leonard.

BENNINGTON, *Bennington Co.* (Pop., est., 5,000.) Engaged in manufacturing. Incorp. No sewers. Has electric lights.

History.—Built in '85-87 by Bennington Water Co. Engrs. and Contrs., not given.

Water Supply.—Springs, by gravity.

Distribution.—*Mains*, c. i., 7 miles. *Services*, lead. *Taps*, 250. *Meters*, 3. *Hydrants*, Ludlow, 33. *Valves*, Ludlow.

Consumption, unknown. *Pressure*, 124 lbs.

Financial.—Cost (in '88), $60,000. Stock, $60,000. Debt, $48,000. Int., 5%. Ann. op. exp., withheld, est., $500. Ann. rev.: consumers, withheld, est., $3,000; city, $1,100. Hydrant rental, $33.33.

Management.—Prest., Henry W. Putnam. V. Prest., Treas. and Supt., E. H. Putnam. Sec., Jno. T. Shurtleff.

BRANDON, *Rutland Co.* (Pop., 3,280; est., not given.) On Otter creek. Engaged in quarrying, and general trade. Settled in 1774, and incorp. as a fire district. Has electric lights but no sewers.

History.—Built in '79 by fire district. Des. Engr., Thos. Ross. Contrs., R. D. Wood & Co., Philadelphia, Pa. Sub-contrs., Inman Bros., New York City.

Water Supply.—Hitchcock's pond by gravity. Pond located in mountains, 5½ miles from, 150 to 180 ft. above, village; area, ½ sq. m.; bottom covered with cobble stones; fed entirely by springs.

Dam.—At outlet. Cost, $500.

Conduit.—C. i.; 7,000 ft. 12-in., 23,465 ft. 8-in. Takes water 10 ft. below surface.

Distribution.—*Mains*, c. i., 10 miles. *Services*, galv. i. *Taps*, 250. *Meters*, none. *Hydrants*, Mathews, 36.

Consumption, not known. *Pressure:* Ordinary and fire, 65 lbs.

Financial.—Cost, $40,000. Debt, $36,000. Int., 4%. Ann. op. exp., $300. Ann. rev.: consumers, $2,300; city, none.

Management.—Prudential Com., Chr., C. W. Briggs.

BRATTLEBORO, *Windham Co.* (Pop., 4,471; est., 6,500.) On Connecticut river. Engaged in manufacturing. Incorp. Has sewers and electric lights.

History.—Built in '84 by Geo. E. Crowell.

Water Supply.—Springs, by gravity.

Reservoir.—Cap., 7,500,000 galls.

Distribution.—*Mains*, c. i., 10 miles; 3 miles added in '89. *Services*, lead. *Taps*, 250. *Meters*, none. *Hydrants*, Chapman, 5. *Valves*, Chapman.

Consumption, 50,000 galls. *Pressure:* Ordinary and fire, 85 lbs.

Financial.—Cost, $100,000. Debt, none. Ann. op. exp., withheld, est., $500. Ann. rev.: consumers, $3,000; city, $250. Hydrant rental, $50.

Management.—Owner, Geo. E. Crowell. Supt., W. E. Eason.

BURLINGTON, *Chittenden Co.* (Pop., 11,365; est., 16,000.) On Lake Champlain, on ground rising gradually from the lake to an elevation of over 300 ft. Has large cotton, woolen, marble, and all kinds of lumber manufactories, and large lumber trade, especially by water. Settled in 1773; incorp. a city in '65. Has sewers and electric lights.

History.—Built by city in '67. Engr., Wm. S. Whitwell.

Water Supply.—Lake Champlain, pumping to reservoirs and to tank for high-service.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; Worthington; dup.

Force Main.—To reservoirs; 10 ins. in diam., and 1¾ miles long.

Reservoirs.—Combined cap., 6,236,000 galls.; two in excavation and embankment, side by side. *Old Reservoir:* Cap., 2,360,000 gals.; 200 ft. sq., 13 ft. deep.; 280 ft. above lake. *New Reservoir:* Cap., 3,876,000 galls. Irregular. Has concrete bottom, and slopes for ⅔ of distance from bottom are lined with brick in cement; remainder of slope is paved with blocks of Barre granite. Built in '88. Contrs., Lang, Goodhue & Co., Burlington.

High Service Tank.—Cap., 100,000 galls.; iron, about 300 ft. above lake.

Distribution.—*Mains*, w. i. and cem., c. i., 30 miles. *Services*, lead and galv. i. *Taps*, 2,433. *Meters*, 445. *Hydrants*, kind not given, 163. *Close of '80:* Mains, 27 miles. Taps, 1,777. Meters, 35. Hydrants, 138.

Consumption, 696,877 galls. *Pressure*, 75 to 85 lbs.

Financial.—Cost, $349,335. Debt, $241,000. Int., 4 and 6%. Sinking fund, $114,000. Ann. op. exp., $13,200. Ann. int., $11,191. Ann. rev.: consumers, $31,506; city, $1,594. Hydrant rental, $1,200 for all, or about $7.40 each. Cost, close of '80, $301,076. Rev., '80, $23,923.

Management.—Three Comrs. chosen by Board of Aldermen. Supt., F. H. Crandall.

REFERENCE.—Tenth Census U. S., Vol. XVII., Water Supply of Cities, p. 211.

FAIRHAVEN, *Rutland Co.* (Pop., 2,111; est., 3,000.) On Castleton river. Has marble and slate quarries. Settled in 1779; incorp. a village in '20. No sewers or electric lights.

History.—Built in '80 by village. Des. Engr., J. J. R. Randall, Rutland. Const. Engr. and Contrs., R. D. Wood & Co., Philadelphia, Pa. Sub.-contrs., Inman Bros., New York City.

Water Supply.—Inman pond, by gravity. Pond has an area of 80 acres, but very small drainage area, being fed by springs; 3.4 miles from. 200 ft. above, village.

Tunnel.—Water taken from a pond through a rock tunnel 150 ft. long, 35 ft. below surface of land adjoining pond.

Distribution.—*Mains*, c. i., 10 miles. *Services*, w. i. *Taps*., 450. *Meters*, none. *Hydrants*, kind not given, 25.

Consumption, 45,000 galls. *Pressure*: 80 to 100 lbs.

Financial.—Cost, $36,000. Debt, $35,000. Int., 4%. Sinking fund, $2,700. Ann. op. exp., $100. Ann. rev.: consumers, $3,500; city, none.

Management.—Three Comrs.: Treas., Frank E. Allen, Will V. Roberts and O. Bryant.

HYDE PARK, *Lamoille Co.* (Pop., 331; est., 500.) On Lamoille river. Settled in 1790; never incorp.

History.—Small system for domestic supply built in '50 by Hyde Park Water Co., now owned by C. S. Page.

Water Supply.—Springs, by gravity and pumping.

Pumping Machinery.—Dy. cap., 20,000 galls.; Curtis double-acting pump, driven by windmill.

Distribution.—*Mains*, iron and lead, 2 miles. *Services*, lead. *Taps*, 45. *Meters*, *and hydrants*, none.

Consumption, 7,000 galls. *Pressure:* very small.

Financial.—Cost, $3,500. Debt, none. Ann. op. exp., $150. Ann. rev.: consumers, $150. Hydrant rental, none.

Management.—Treas. and Gen. Mgr., C. S. Page. Supt., Isaac C. Vaughan.

ISLAND POND, *Essex Co.* (Pop., 300; est., 2,000.) Engaged in lumbering Incorp. No sewers or electric lights.

History.—Built in '79 by Island Pond Aqueduct Co.

Water Supply.—Springs, by gravity.

Distribution.—*Mains*, c. i., lead, 3 miles. *Services*, lead. *Taps*, 100. *Meters*, none. *Hydrants*, Mathews, 5.

Consumption, 30,000 galls. *Pressure*: Ordinary and fire, 100 lbs.

Financial.—Cost, $12,000. Debt, none. Ann. op. exp., $200. Ann. rev.: consumrs. $1,200; city, $50. Hydrant rental, $5.

Management.—Owner, G. W. Noyes.

MONTPELIER, *Washington Co.* (Pop., 1,847; est., 3,220.) On Winooski river, in hilly country. Settled in 1787, incorp. a village in '18. No sewerage system. Has electric lights

THE HUBBARD WORKS.

History.—Begun in '20 by Roger Hubbard, continued by his son, Erastus Hubbard, and now owned by Jno. E. Hubbard, grandson of the first owner. For domestic use, only.

Water Supply.—Springs in surrounding hills, conveyed to village in lead and c. i. pipes, the latter being added in '84, and connected with a small reservoir.

Distribution.—*Mains*, 8½ miles. *Taps*, 185.

Consumption, unknown. *Pressure*: 82 lbs.

Financial.—Cost, unknown, est., $40,000. Ann. op. exp., withheld, est., $300. Ann rev.: consumers, withheld, est., $1,500.

Management.—Owner and Supt., Jno. E. Hubbard.

NOTE.—A full and interesting description of the construction and extension of these works was given in *Eng. News*, Vol. XV., pp. 331-2.

VILLAGE WORKS.

History.—Built in '84. Engr., Joel Foster.

Water Supply.—Berlin pond, by gravity; area, 1 sq. m.

Dam and Reservoir.—Cap., 4,500,000 galls.; 364 ft. above village. Dam is a mile below pond, of rubble masonry and cem., 14 ft. high, 25 ft. long.

Distribution.—*Mains*, c. i., w. i., 15 miles. *Services*, w. i., c. i. pipe from Warren Foundry & Machine Co., Phillipsburgh, N. J.; trenching done by L. F. Maloy, pipe-laying by village. *Taps*, 503. *Meters*, 4. *Hydrants*, Ludlow, 54.

Consumption, unknown. *Pressure:* 156 lbs.

Financial.—Cost, $101,343. Debt, 81,000. Int. 4½%. Ann. op. exp., $2,705. Ann. rev.: consumers, $5,122; city, 2,080. Hydrant rental, $40. First cost, about $70,000.

Management.—Five Comrs. Supt., Joel Foster.

MORRISVILLE, *Lamoille Co.* (Pop., est., 2,000.) On Lamoille river. Incorp. a village.

History.—Built in '85 by Morrisville Aqueduct Co., under direction of C. C. Warren, Waterbury.

Water Supply.—Springs, by gravity.

Distribution.—*Mains*, c. i., 6 miles. *Taps*, 150. *Hydrants*, Mathews, 10.

Financial.—Cost, $25,000. Ann. op. exp., not given, est., $200. Ann. rev.: consumers, not given, est., $1.500.

Management.—Prest. and Supt., C. C. Warren, Waterbury, Secy., Wm. Gould.

NEWPORT, *Orleans Co.* (Pop., 920; est., 2,000.) On Lake Memphremagog. Summer resort and manufacturing village.

History.—Built by city in '85. Engrs. and Contrs., Geo. F. Blake Manufacturing Co., N. Y. City.

Water Supply.—Lake Memphremagog, direct pumping.

Pumping Machinery.—Dy. cap., 400,000 galls.; Knowles.

Distribution.—*Mains*, 8 and 6-in. c. i., 2 miles. *Services*, w. i. *Taps*, 50. *Meters*, none. *Hydrants*, Chapman, 17. *Valves*, Chapman.

Consumption, 100,000 galls. *Pressure*: Ordinary, 80 lbs. Fire, 90 lbs.

Financial.—Cost, $10,000. Debt, none. Ann. op. exp., $250. Ann. rev.: consumers, $600; city. none.

Management.—Operated by Prouty & Miller.

NORTHFIELD, *Washington Co.* (Pop., 1,313; est., 2,000.) Has slate quarries. Not incorp. Has no sewers or electric lights.

History.—Built in '54 by Co.s and sold since to Northfield Aqueduct Co.; improvements completed in '86.

Water Supply.—Springs, by gravity.

Distribution.—*Mains*, iron, 5 miles. *Services*, iron. *Taps*, 86. *Meters* and *hydrants*, none; water is stored in 7 reservoirs for fire protection.

Consumption, unknown. *Pressure*: 300 ft. head.

Financial.—Cost; present company bought the works for $10,000; original cost said to be $36,000. Debt, none. Ann. op. exp., $100. Ann. rev.: consumers, $1,000; city, not given. No hydrant rental.

Management.—Prest., Ed. S. Steffins. Secy. and Treas., Ira Beard. Supt., Wm. M. Davis.

POULTNEY, *Rutland Co.* (Pop., est., 1,600.) On Poultney river, 18 miles from Rutland. Has manufactories. Incorp. fire district. No sewers or electric lights.

History.—Built in '89, put in operation Nov. 14, by fire district. Des. Engr., Prof. D. M. Greene, Troy, N. Y. Contr., Adam Miller, Saratoga Springs, N. Y.

Water Supply.—Crystal lake, by gravity. Lake in Hampton, N. Y.; cap., 38,000,000 gal.; 1.6 miles from, 276 ft. above, town.

Distribution.—*Mains*, 8 to 3-in., c. i., about 4 miles. *Services*, not given. Pipe and specials from Warren Foundry & Machine Co., Phillipsburgh, N. J. *Hydrants*, Ludlow, 41. *Valves*, Ludlow. *Pressure:* 120 lbs.

Financial.—Cost, $27,800. Debt, $27,800; $30,000 of bonds. Int., 4%.

Management.—Three Comrs. Chn., M. J. Horton. Supt., Thos. B. Clark. Latest report by M. J. Horton; date, Feb. 1, '90.

RICHFORD, *Franklin Co.* (Pop. 789; est., 1,000.) On Missisquoi river Manufactures lumber. Incorp., village. No sewers. Has electric lights.

History.—Built in '89. put in operation in Aug., by village.

Water Supply.—Springs, by gravity.

Reservoir.—Cap., 1,000,000 galls.

Distribution.—*Mains*, c. i., 4½ miles. *Services*, iron. *Taps*, 125. *Meters*, not given *Hydrants*, Ludlow, 29. *Valves*, Ludlow.

Financial.—Cost, $16,669. Debt, withheld [probably for full amount of cost]. Int., 4½%.

Management.—Comr., J. C. Baker. Date report, Nov. 24, '89.

RUTLAND, *Rutland Co.* (Pop., 7,502; est., 10,000.) On East creek, near Otter creek. Has large marble quarries; engaged in manufacturing. Incorp. a village. Has sewers and electric lights.

History.—Built in '56 by village. In '79 a new distributing system was put in; Engr., L. M. Davis, the Supt.; Contrs., Sherman & Flagler, now Troy (N. Y.) Public Wks. Co.; Consulting Engr., N. Henry Crafts, Boston, Mass.

Water Supply.—Mendon river, by gravity to and from settling and distributing reservoirs. Supply formerly from East creek and Tanyard brook.

Settling Reservoirs.—Two. Cap., 150,000 and 1,000,000 galls., respectively; first is 50 x 100 ft., x 4 ft. deep; second 80 x 200 ft., x 9 ft. deep. Water passes from the river to first through an old water course, and thence to second through bed of gravel between the two.

Conduit to old filter gallery; 12-in. c. i., length not given.

Old Filter Gallery.—About 80 ft. from East creek, one of the former sources of supply; 6 x 200 ft., 9 ft. high, top being arched; low-water line at spring of arch. Side walls, masonry, 3 ft. thick at bottom and 2½ at top; arched top, of brick. There was a shaft at each end, and gate-house beyond one of the shafts.

Conduit to distributing reservoir: Of 12 and 6-in. c. i., 3½ miles long.

Distributing Reservoir.—Cap., 1,000,000 galls.; trapezoidal plan, being 65 x 67½ x 35 x 58 ft., x 15 ft deep; earth, with heart-wall. High water is 156 ft. above lowest part of city. Both slopes are 1½ to 1, inner covered with 6 ins. of riprap. *Heart-wall*: puddle, 4 ft. thick.

Distribution.—*Mains*, c. i., 15 miles. *Services*, w. i. *Taps*, 1,050. *Meters*, none. *Hydrants*, Mathews, 60.

Consumption, 1,000,000 galls. *Pressure*: Ordinary and fire, 60 lbs.

Financial.—Cost, $100,000. Debt, $67,500: $62,500 at 5, and $5,000 at 4½%. Ann. op. exp., $3,000. Ann. rev.: consumers, $17,000; city, none.

Management.—Comrs., W. C. Landon, J. M. Davis, N. L. Davis. Supt., J. M. Davis.

Reference.—Tenth Census U. S., Vol. XVII., Water Supply of Cities, pp. 45-6.

SAINT ALBANS, *Franklin Co.* (Pop., 7,193; est., 7,500.) Butter market for northern Vermont. Incorp. a village in '59. Has sewers and electric lights.

History.—Built in '73 by village. Engr., Jno. T. Fanning, Minneapolis, Minn.

Water Supply.—Surface water, by gravity. Drainage area, 3 sq. m.

Dam and Reservoir.—Cap., 100,000,000 galls.; area, 28 acres; 336 ft. above town. Dam across small stream, of earth, 400 ft. long, 28 ft. high, 20 ft. wide on top inner slope, 2½ to 1; outer, 1½ to 1. Also an embankment extending 1,950 ft. across low ground.

Conduit.—W. i. and cem., 12-in., 3½ miles long.

Distribution.—*Mains*, w. i. and cem., 14 miles. *Services*, galv. i. *Taps*, 900. *Meters*, none. *Hydrants*, Whittier, Perkins, 65. *Gates*, Eddy, Ludlow.

Consumption est., 600,000 galls. *Pressure:* 110 lbs.

Financial.—Cost, $175,000. Debt, $150,000. Int., 5%. Sinking fund, $48,000. Ann. op. exp., $1,640. Ann. rev.: consumers, $8,942.

Management—Five Trustees. Sec. and Treas., B. D. Hopkins. Supt., Marshall Mason.

SAINT JOHNSBURY, *Caledonia Co.* (Pop., 3,360; est., 5,000.) On Passumpsic river, in hilly region. Engaged in manufacturing. Settled in 1787: incorp. a village in '52.

ST. JOHNSBURY AQUEDUCT CO.'S WORKS.

History.—Built in '60.

Water Supply.—Springs, by gravity.

Conduit.—Of 6-in. cement-lined c. i., 4 miles long; av. head, 170 ft.

Distribution.—*Mains*, 4 and 3-in.

Financial.—First cost, about $50,000.

No further data.

VILLAGE WORKS.

History.—Built in '76 by village. Engr., J. P. Flanders. Contrs., Vergennes Machine Co., of Vergennes, now out of business.

Water Supply.—Passumpsic river, direct pumping. Drainage area, 1,000 acres.

Dam.—Timber, furnishes water-power to drive pump.

Filter.—Sand, 12 x 15 ft., x 4 ft. deep; between dam and pump.

Pumping Machinery.—Dy. cap., 2,500,000 galls.; two Flanders water-power pumps, large and small. *Water-wheels:* A 30 and a 50-in. Buzzell, under 12-ft. head.

Distribution.—(In '87.) *Mains*, 12 to 2-in. iron, 8 miles. *Services*, galv. i. *Taps*, (in '86), 333. *Meters*, none. *Hydrants*, Pattee & Perkins, 78.

Consumption, about 500,000 galls. *Pressure:* Ordinary, 90 lbs. Fire, 112 lbs.

Financial.—Cost (in '87), $80,000. Debt (in '88), $62,500. Int., 4 and 4½ %. Ann. op. exp., about $1,000. Ann. rev.: net, $4,745.

Management.—Supt., Geo. Ranney.

SPRINGFIELD, *Windsor Co.* (Pop., 1,589; est , 3,300.) On Connecticut and Black rivers. Engaged in manufacturing. Incorp. Sewers built in '89. No electric lights.

History.—Built in '84 by Springfield Village Water Supply Co. for domestic supply.

Water Supply.—Four springs, at an elevation of 150 ft., by gravity.

Distribution.—*Mains*, lead, ½ mile. *Services*, lead. *Taps*, 24.

Consumption, 4,800 galls *Pressure*, 150-ft. head.

Financial.—Cost, 2,000. No debt. Ann. op. exp., nominal. Ann. rev.: consumers, $250.

Management.—Owned and operated by Albert Brown.

SWANTON, *Franklin Co.* (Pop., 3,079.) On Missisquoi river. Incorp. No sewers or electric lights.

History.—Built in '87 by Swanton Water-Works Co., which acted as a construction company, and was composed of F. Tarble, Henry M. Stone and E. W. Jewett. Village took the works Aug. 1, '89, at cost and int. Engr., W. H. Lang. Contrs., W. H. Lang, Goodhue & Co., Burlington.

Water Supply.—Missisquoi river, direct pumping.

Filter. Sand and gravel.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Lang triplex, driven by Hercules turbine.

Distribution.—*Mains*, 8 to 4-in. Wyckoff wood, 3 miles. *Services*, iron. *Taps*, 110. *Meters*, none. *Hydrants*, Lang, 32. *Valves*, Lang.

Consumption, 250,000 galls. *Pressure:* Ordinary, 50 lbs. Fire, 110 lbs.

Financial.—Cost, $20,000. Debt, $14,500. Int., 4 %. Ann. op. exp., $300. Ann. rev.: consumers, $1,200.

Management.—Village Clerk, T. M. Tobin. Supt., W. H. Thomas.

VERGENNES, *Addison Co.* (Pop., 1,782; est., 1,800.) On Otter creek. Has some manufactories. Settled in 1766; incorp. a city in 1788. Has sewers. No electric lights.

History.—Built in '69 by city.

Water Supply.—Otter creek, filtered, direct pumping.

Filter.—Sand and gravel.

Pumping Machinery.—Dy cap., not given; two Flanders piston, driven by water-power, and 1,000,000 Holly.

Distribution.—*Mains*, 10 to 4-in. c. i., 7 miles. *Services*, iron. *Taps*, about 300. *Meters*, none. *Hydrants*, Lang, 35. *Valves*, Eddy.

Consumption, 90,000 galls. *Pressure:* Ordinary, 80 lbs. Fire, 150 lbs.

Financial.—Cost, $75,000. Debt, $58,000: $32,000 at 6, and $26,000 at 4%. Ann. op. exp., about $1,100. Ann. rev.: consumers, $2,980; city, none.

Management.—Three Comrs. Chr., S. D. Miner.

WATERBURY, *Washington Co.* (Pop , 756; est., 1,500.) Incorp. No sewers or electric lights.

History—Built in '79 by Warren & Somerville, after plans by C. C. Warren.

Water Supply.—Springs, by gravity.

Distribution.—*Mains*, c. i., 7 miles. *Services*, w. i. *Taps*, 100. *Meters*, none. *Hydrants*, Ludlow, 2.

Consumption, not given. *Pressure:* Ordinary and fire, 65 lbs.

Financial.—All withheld. *Est.:* Cost, $25,000. Ann. op. exp., $200. Ann. rev.: consumers, $1,500.

Management. Supt., C. C. Warren. Village Clerk, G. C. Washburn.

WEST RANDOLPH, *Orange Co.* (Pop., 1,069; est., 1,500.) Engaged in manufacturing. Incorp. a village. No sewers or electric lights.

History.—Built in '78 by village. Engr., Joel Foster, Montpelier. Work done by village.

Water Supply.—Springs and brooks, 2¼ miles from, and 243 ft. above, village, by gravity.

Reservoir.—Cap., 1,000,000 galls.; ½ mile from, and 243 ft. above, village. Oval, three sides solid rock, one of earth. Banks, 8 ft. wide on top, 28 ft. at bottom.

Distribution.—*Mains*, 10 to 4-in., c. i., 5½ miles. *Services*, tarred w. i. Pipe from Warren Foundry & Machine Co., Phillipsburgh, N. J. *Taps*, 190. *Meters*, 2. *Hydrants*, Ludlow, 34. *Valves*, Ludlow.

Consumption, not given. *Pressure*: 105 lbs.

Financial.—Cost, $22,000. Debt, $22,000. Int., 4%. Ann. op. exp., $200. Ann. rev.: consumers, $1,300; city, $195. Hydrant rental, $15.

Management.—Five Comrs. Chn., Wm. H. DuBois. Village Clerk, E. O. Hibbard. Supt., Lemuel Richmond.

WINDSOR, *Windsor Co.* (Pop., 2,175; est., 2,200.) On Connecticut river. Center for agricultural and dairy trade. Incorp. village. Has main sewer. No electric lights.

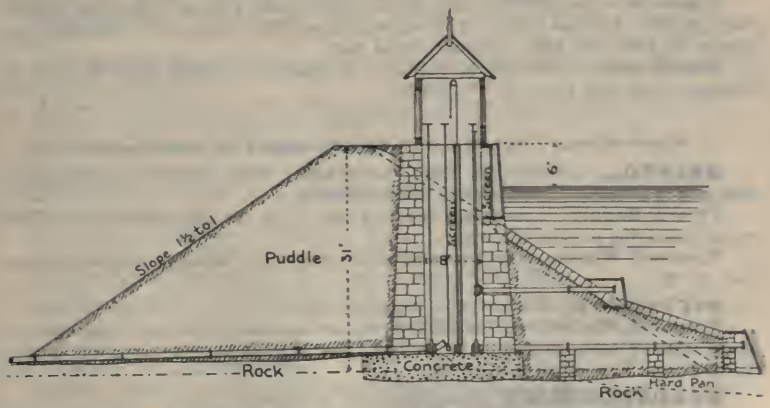
WINDSOR AQUEDUCT CO.'S WORKS.

General Description.—Small gravity system was built in '50. Supply from Dudley brook. Iron, cem. and lead pipe used; cost, $2,500. Officers: Prest., L. W. Stocker; Treas., L. C. White.

VILLAGE WORKS.

History.—Built in '88. Engr., Geo. Leland, Providence, R. I.

Water Supply.—Dudley brook, by gravity from impounding reservoir. Drainage area, 1 sq. m.



Section, Dudley Brook Dam and Gate-house, Windsor, Vt.

Dam and Reservoir.—Cap., 4,000,000 galls.; area, ¾ acres. Dam of puddled clay and gravel, without heart-wall; 170 ft. long, 31 ft. high, water 6 ft. from top; 4 ft. thick at top, 97 at base; both slopes 1½ to 1, inner paved with, 14 ins of stone, outer, sodded. Foundation, ledge in center, clay bank on south side. Cut-off trench near middle, 4 ft. wide, 2 ft. deep, filled with puddle. *Spillway:* in dam, at north end, masonry, free; 36 ft. long, 6 ft. deep. *Discharge pipes:* two, 10-in. supply, 8-in. waste. See accompanying section through gate-house. Dam does not leak. Built in '88. Engr. See History. Built by village, under direction of Jno. T. Langford, Boston.

Distribution.—*Mains*, 8 to 4-in. c. i., 4.6 miles. *Services*, ¾-in. tarred i. Pipe from Donaldson Iron Co., Emaus, Pa.; trenching and pipe-laying done by Jno. T. Langford, 70 Kilby St., Boston, Mass. *Taps*, 180. *Meters*, none. *Hydrants*, Ludlow, 40. *Valves*, Ludlow.

Consumption, unknown. *Pressure:* 100 to 112 lbs.

Financial.—Cost, $35,000. Debt, $35,000: $10,000 at 5, $25,000 at 4%. Ann. op. exp., not determined. Ann. rev.: consumers, est., $2,000; city, $800. Hydrant rental, $20.

Management.—Village Clerk, Geo. T. Winn. Supt., C. D. Penniman.

WINOOSKI, *Chittenden Co.* (Pop., 2,833; est., 3,500.) On Winooski river, near Burlington. Engaged in manufacturing lumber, woolen aad other goods. Incorp. Has sewers and electric lights.

History.—Built in '73 by Winooski Aqueduct Co.

Water Supply.—Springs, by gravity.

Reservoir.—Cap., 5,000,000 galls.

Distribution.—*Mains*, c. i., 6 miles. *Services*, galv. i. *Taps*, 400. *Meters*, 6. *Hydrants*, Chapman, 20. *Valves*, Chapman.

Consumption, about 160,000 galls. *Pressure*: 65 lbs.

Financial.—Cost, $35,000. Debt, none. Ann. op. exp. (in '87), $1,500. Ann. rev.: consumers (in '87), $3,000; city, $600. Hydrant rental, $30.

Management.—Prest., Jos. Sawyer. Secy. and Treas., F. C. Kennedy. Engr., G. D. Nash.

WOODSTOCK, *Windsor Co.* (Pop., 1,266; est., 1,500.) On Ottaqueachy river. Incorp. No sewers or electric lights.

History.—Built in '87 by Woodstock Aqueduct Co. Des. Engr., J. J. R. Randall, Rutland. Contrs., R. D. Wood & Co., Philadelphia, Pa., who furnished all material; sublet to T. Wm. Harris, 45 Broadway, New York City.

Water Supply.—Streams, by gravity.

Reservoir.—Cap., about 4,000,000 galls.; enlarged in '88 from original cap. of 2,500,000 galls.

Distribution.—*Mains*, 8 to 4-in. c. i., 7 miles. *Services*, galv. i. *Taps*, 160. *Meters*, none. *Hydrants*, Mathews, 38. *Valves*, Eidy.

Consumption, unknown. *Pressure:* Ordinary and fire, 110 lbs.

Financial.—Cost, $38.000. Cap. stock: authorized, $36,0 0; subscribed $32,250. Debt, $3,100. Int., not given. Ann. op. exp., about $600. Ann. rev.: consumers, for part of '88, $744; city, $840. Hydrant rental, $40.

Management.—Prest., F. N. Billings. V. Prest., F. S. Mackenzie. Secy., H. C Phillips. Supt. and Treas., F. W. Wilder.

Water-Works Projected with Fair Prospects of Construction.

BRISTOL, *Addison Co.* (Pop., town, 1,579.) Is 25 miles from Burlington. Engaged in farming, lumbering and manufacturing.

Present Supply.—Unofficially reported that W. A. Munsill, Malone, N. Y., has works supplying portion of town.

Proposed Works.—More extended works projected; nothing definite decided Oct. 15, '89.

PITTSFORD, *Rutland Co.* (Pop., est., 500.)

Proposed Works.—Co. to build in '90; not organized. Supply, Sugar Hollow brook, about 2 miles from town, by gravity. Est. cost, $6,000. Report by C. S. Colburn, Town Clerk; date, Nov. 21, '89.

READSBOROUGH *Bennington Co.* (Pop., town, 743.)

Proposed Works.—Unofficially reported, latter part of '89, that town had awarded contract for construction of $10,600 works, and that pipe was being laid from Toby brook to town.

MASSACHUSETTS.

Water-Works Completed or in Process of Construction.

ABINGTON, *Plymouth Co.* (Pop., 3,697; est., 4,000.) Engaged in manufacturing boots and shoes and tacks. No sewers or electric lights.

History.—Built in '86 by town. Pumping machinery, stand-pipe and 6 miles of the mains are owned jointly with adjoining town of Rockland. Des. Engr., S. C. Heald, Boston. Const. Engr., J. J. Van Volkenburg, Worcester.

Water Supply.—Big Sandy pond in town of Pembroke, pumping to stand-pipe.

Pumping Machinery.—Cap., 3,000,000 galls.; two Worthington high-service, with dy. cap. of 2,000,000 and 1,000,000 galls., and guaranteed duty of 85,000,000 ft. lbs. per 100 lbs. of coal. Price of engines, boilers and fittings, $32,000.

Stand-Pipe.—Cap., 368,000 galls; 25x100 ft. On Beach hill in Rockland, 5 miles from, 230 ft. above, the pond; 129 ft. above Rockland, 135 ft. above Abington. Built by Cunningham Iron Works, Boston, for $12,700.

Distribution.—*Mains*, c. i., 17.6 miles. *Services*, cem.-lined i. Pipe from Warren Foundry & Machine Co., Phillipsburgh, N. J.; laid by T. F. Maney & Co., Boston. *Taps*, 532. *Meters*, 55. *Hydrants*, Coffin, 122. *Valves*, Coffin.

Consumption, 150,000 galls. *Pressure:* 75 lbs.

Financial.—Cost, $155,000. Debt, not given. Int., 4%. Ann. op. exp., withheld, est., $3,500. Ann. rev.: consumers, $6,000; city, $2,440. Hydrant rental, $20. No other data given.

Management.—Three Comrs. Supt., A. H. Wright.

ADAMS, *Berkshire Co.* (Pop., 2,388; est., 9,000.) In valley of south branch of Hoosac river. Engaged in manufacturing cotton, woolen, paper and celluloid goods. Settled in 1740. Has electric lights.

History.—Built in '73 by village.

Water Supply.—Bassett and Dry brooks, by gravity from impounding reservoir on each; also emergency supply from well at Renfrew mills, by pumping to reservoirs.

Dams.—Stone and cement, 60 ft. long, 12 ft. high.

Reservoirs.—Cap., about 10,000,000; two of about equal cap.

Filter.—Gravel and sand.

Supply Main.—Iron, 12-in.

Distribution.—(For '87.) *Mains*, 12 to 4-in. c. i., 11 miles. *Services*, w. i. *Taps*, about 1,800. *Meters*, 14. *Hydrants*, Ludlow, Chapman, 160. *Valves*, Ludlow, Chapman.

Consumption, about 800,000 galls. *Pressure:* Ordinary, 110 lbs. Fire, 110 to 140 lbs.

Financial.—(For '87.) Cost, $140,878. Debt, $120,500. Int., 5%. Ann. op. exp., not given, est., $3,000. Ann. rev.: consumers, $11,933; city none.

Management.—Three Comrs. Clerk and Treas., Dan'l Upton. Supt., C. A. Waters.

AGAWAM. *Hampden Co.* (Pop., 2,216.) On Connecticut river. Settled in 1660. Incorp. town in '58.

History.—Built in '77 for domestic use by C. L. Goodhue, Springfield.

Water Supply.—Springs, by gravity.

Dam.—Of puddled clay; small.

Conduit.—Of 6-in. w. i. and cement.

Distribution.—*Mains*, w. i., cement, 5 miles. *Services*, galv. i. *Taps*, 74. No meters or hydrants.

Consumption, unknown. *Pressure*, 45 lbs.

Financial.—Cost, $6,000. No debt. No other data.

Management.—Owned by C. L. Goodhue, Springfield, Mass.

AMESBURY, *Essex Co.* (Pop., 7,434; est., 9,000.) On Powow river. Engaged in manufacturing woolen goods, cotton machinery, patent flooring and carriages. In '86 large part of town of Salisbury was annexed to Amesbury. Not incorp. Partially sewered. Has electric lights.

History.—Built in '84 by Powow Hill Water Co. to supply Amesbury and Salisbury. Des. Engr., Chas. A. Smith. Const. Engrs., Chas. A. Smith and Walter H. Sears.

Water Supply.—Driven wells, pumping to reservoir. There are 14 2-in. tube wells, sunk for 16 ft. in bottom of basin, 14 ft. deep. Auxiliary supply is taken from second basin, near first, 40 × 80 ft. Formerly several wells were connected with horizontal suction pipe, and latter with pumps 15 ft. below ground. In '86 these pumps were abandoned.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two 1,000,000 Worthington. *Boilers:* two 60 H. P. tubular.

Reservoirs.—*Low Service:* cap. 300,000 galls.; 140 ft. above village. *High Service:* cap., 2,000,000 galls.; 240 ft. above village and 200 above pumps; in earth excavation, having inner slopes puddled, and paved with boulders.

Distribution.—*Mains*, c. i., 9 miles. *Services*, at first, w. i. and cement; now tarred w. i. Pipes and specials from Gloucester Iron Works, Gloucester, N. J., and R. D. Wood & Co., Philadelphia, Pa. *Taps*, 700. *Meters*, 56. *Hydrants*, Ludlow 220. *Valves*, Ludlow.

Consumption, not given. *Pressure:* Ordinary, 50 lbs. Fire, 100 lbs.

Financial.—Cost, $100,000; cap. stock, $400,000. Debt, $48,000; bonds, $40,000; loans, $8,000. Int., 5%. Ann. op. exp., withheld, est., $3,000. Ann. rev.: consumers, $6,500; city, $3,500. Hydrant rental, $30 for first 100, $25 for additional.

Management.—Prest., Richard F. Briggs. Secy, Geo. W. Cate. Treas., E. R. Sibley.

AMHERST, *Hampshire Co.* (Pop., 4,298; est., 4,298). On Connecticut River; has good water-power. Settled in 1721; incorp. in 1759. Has electric lights.

History.—Built in '79 by Amherst Water Co. Des. Engr., Phineas Ball, Worcester. Const. Engrs. and Contrs., Goodhue & Birnie, Springfield. In '87 or '88, above company bought out Pelham Spring Co., which built works in '83.

Water Supply.—Amethyst brook and springs in Pelham, by gravity. Stream has drainage area of 3 sq. m.; springs are collected in 7 wells, from which water flows to covered reservoir, as below.

Amethyst Brook Dam and Reservoir.—Cap., 2,700,000 galls.; 150 to 350 ft. above village. *Dam*, masonry, 150 ft. long, 19 ft. high, 8 ft. wide at top, 20 at bottom.

Pelham Springs Reservoir.—Cap., about 100,000 galls.; covered, 70 x 40 ft. x 6 deep.

Distribution.—*Mains*, c. i and cement, 7 miles. *Taps* (in '86), 200. *Meters*, none. *Hydrants*, Holyoke, 25. *Valves*, Chapman.

Consumption, unknown. *Pressure*, 100 lbs.

Financial.—Cost, $80,000. Cap. stock, $40,000. Bonded debt, $40,000. Int. 5% Ann. op. exp., withheld; est., $1,500. Ann. rev.: consumers, withheld, est., $8,000, city, $1,000. Hydrant rental, $1,000 for any number.

Management.—Prest., W. A. Dickinson. Secy. and Treas, E. D. Bangs. Supt., P. E. Irish.

NOTE.—Figures under Distribution and Financial are those given in '86 and '87, except where est., but Co. reports "no change from last year."

ANDOVER, *Essex Co.* (Pop., town, 5,169; est., 6,500.) Incorp. town. No sewers. Has electric lights.

History.—Built Oct., '89, to June, '90, by town. Engr., Percy M. Blake, Hyde Park, Mass.

Water Supply.—Haggett's pond, pumping to reservoir. Est. cap. of pond, 800,000,000 galls.

Pumping Machinery.—Dy. cap., 1,728,000 galls.; Blake dup., direct-acting. *Boilers*, Blake.

Reservoir.—Cap., 1,250,000 galls.

Distribution.—*Mains*, c. i., 20 miles. *Services*, w. i. and cem. Pipe and specials from R. D. Wood & Co., Philadelphia, Pa.; trenching and pipe-laying done by Chas. H. Eglee, Flushing, N. Y. *Meters*, Crown, number not determined. *Hydrants*, Ludlow, number not given. *Valves*, Ludlow.

Pressure, 40 to 100 lbs.

Financial.—Cost, est., $150,000. Bonded debt, $150,000. Int., 4 %.

Management.—Three Comrs. Secy., Felix G. Haynes. Supt., John E. Smith. Date of latest report, Dec. 4, '89.

ARLINGTON, *Middlesex Co.* (Pop., 4,100; est., 5,000.) On broken ground at head of Mystic river, 6 miles from Boston. Engaged in vegetable gardening, drug and general manufacturing. Settled in 1735; incorp. as West Cambridge in '07; name changed to Arlington in '67. No sewers. Has electric lights.

History.—Built in '73 by town. Engrs., W. A. Mason and C. D. Elliott, Somerville, Mass. Contr., Geo. H. Norman, Newport, R. I. Extensions made by Water Comrs. with day labor.

Water Supply.—Lexington Great Meadows and North brook, by gravity from storage reservoir on latter.

Dam and Reservoir.—Cap., 77,000,000 galls.; area, 31 acres; depth, 10 ft. *Dam*: earth, with puddle heart-wall, 850 ft. long, 13 ft. high.

Filters.—Bed of reservoir being of peat formation, water was found to have unpleasant taste and odor, so in '76, filter gallery was built in porous ground near reservoir; size, 135 x 12 ft., with stone walls 4 ft. high, arched over with 8 ins. of brick. Bottom was 12 ft. below surface of ground. From one end semi-circular brick arch with 20-in. span, built on timber flooring, connects with 12-in. c. i. pipe leading to supply pipe from reservoir. In '77, second filter gallery was built parallel to first, inside reservoir being brick culvert of 4-ft. span, connected at each end with first gallery by drain pipes laid with open joints. In '80, this gallery was extended 100 ft. Yield is small, soil not being favorable for infiltration.

Brick Conduit.—Built in '77 to divert water to reservoir from Great Meadows and Brown's brook; diam., 3 ft.

Distribution.—*Mains*, w. i. and cem., 16 miles. *Services*, w. i. and cem. *Taps*, 800. *Meters*, 1. *Hydrants*, 106, Gates, Chapman.

Consumption, unknown. *Pressure*, 50 lbs., in center of town.

Financial.—Cost, $310,500. Debt, $220,000 at 6, $80,000 at 5%. Sinking fund, $23,535. Ann. op. exp., $2,780. Ann. int., $17,200. Ann. rev.: consumers, $11,218; city, $1,200. Hydrant rental, $1,000 for any number, or about $10 each. First cost, $300,000, including $80,000 for lawsuits and damages. Total cost to Dec. 31, '88, including int. and op. exp., about $570,000.

Management.—Four Comrs. Supt., Thos. Roden.

ASHBURNHAM, *Worcester Co.* (Pop., 1,666; est., 2,000.) Not incorp. No sewers or electric lights.

History.—Built in '70 by private Co. Engr., G. C. Winchester.

Water Supply.—Springs, by gravity from impounding reservoir.

Dam and Reservoir.—Cap., 1,000,000 galls.; ½ mile from, and 100 ft. above, village. *Dam:* masonry, across ravine. No further data.

Distribution.—*Mains*, sheet i. and cem., 1 mile. *Services*, iron *Taps*, 30. *Meters*, none. *Hydrants*, Whittier, 7.

Consumption, unknown. *Pressure*, 100 lbs.

Financial.—Cost, $5,000. No debt. Ann. op. exp., $50. Ann. rev.: consumers, $250.

Management.—Prest., I. W. Adams, Boston. Secy., W. R. Adams. Treas., G. G. Rockland. Supt., Ezra Merritt.

ATHOL, *Worcester Co.* (Pop., 4,307; est., 4,758.) On Miller's River, which affords good water-power. Engaged in manufacturing. Not incorp. No sewers. Has electric lights.

History.—Built in '76 by Athol Water Co., under direction of S. L. Wiley.

Water Supply.—Philipston and Buckman brooks, by gravity from impounding reservoir on each to distributing reservoir.

Dams.—But one described; puddled earth, masonry heart-wall; 450 ft. long, 18 ft. high. Cost, about $16,000.

Reservoirs.—Cap., not given. *Philipston Brook Reservoir:* Area, 20 acres; depth, 15 ft.; 400 to 500 ft. above town. *Buckman Brook Reservoir:* Area, 8 acres; depth, 12 to 15 ft. *Distributing Reservoir:* Area, about one acre.

Filter.—At impounding reservoir; sand and charcoal; 4 ft. sq.

Distribution.—*Mains*, c. i., 12 miles. *Services*, kal. i. *Taps*, 482. *Meters*, 15. *Hydrants*, Ludlow, 56. *Valves*, Ludlow, Chapman.

Consumption, unknown. *Pressure:* Ordinary, 140 lbs. Fire, 175 lbs.

Financial.—Cost, $140,000. Debt, $140,000. Int., 6%. Ann. op. exp., $1,200. Ann. rev.: consumers, $4,874; city, $2,800. Hydrant rental, $50.

Management.—Prest., S. L. Wiley, Omaha, Neb. Secy., Treas. and Supt., A. MacDonald.

ATTLEBOROUGH, *Bristol Co.* (Pop., est., 6,000.) On Ten Mile River. Engaged in manufacturing, especially jewelry. Settled in 1696. Incorp. Partially sewered. Has electric lights.

History.—Built in '73 by town. Engr., Geo. H. Norman, Newport, R. I. Consulting Engr., M. M. Tidd, Boston.

Water Supply.—Well and Ten Mile River, pumping to tank, and direct pumping from river for fire purposes. *Well:* 25 ft. in diam., by 20 ft. deep. In '81, a gallery, 50 ft. long by 3 ft. sq., was connected with well. There are five 2-in. tube wells in bottom of gallery and three in well.

Pumping Machinery.—Dy. cap., 250,000 galls.; Worthington, built in '74. Pumping done by A. Bushee & Co., under contract with town. Blake comp., dup., put in operation Feb., '89.

Tank.—Cap., 215,000 galls. Plate-iron, inclosed with bricks laid in cement and covered; 40 ft. high; bottom, 22½ ft. above Boston & Providence R. R.

Distribution.—*Mains*, 4 to 10-in. w. i. and cem., 16 miles. *Services*, w. i. and cem., galv. i. *Taps*, about 800. *Meters* (in '87), 328. *Hydrants*, home-made, 111. *Valves*, Ludlow.

Consumption, 100,000 galls. *Pressure:* Ordinary, 44 lbs. Fire, 76 lbs.

Financial.—Cost, $113,758; first cost, $60,000. Debt, $72,000: $40,000 at 7, $32,000 at 4%. Sinking fund, $3,500. Ann. op. exp., $3,600. Ann. rev.: consumers, $7,500.

Management.—Secy., Newton J. Wheat. Treas., Mark O. Wheaton. Registrar and Supt., Geo. B. Fittz.

AVON, *Norfolk Co.* (Pop., est., 1.500.) Incorp. town. No sewers or electric lights.

History.—Built latter part of '89 by town. Engr., L E. Hawes, 75 State St. Boston.

Water Supply.—Surface well, fed by spring, pumping direct and to stand-pipe. *Well:* Av. diam., 20 ft.; depth, 22 ft.; walled with heavy rubble stone masonry, laid dry, lined with 12-in. brick wall beginning 6 ft. from bottom: whole surmounted by conical roof. Is 15 ft. from Porter's spring, which was permanently sealed by bed of concrete. Overflow, 4 ins. from top. Water rises 3 ft. above original level of spring. Contrs., Geo. M. Atkins & Co., Palmer, Mass. Cost, about $3,000.

Suction Pipe.—Diam., 10 ins.

Pumping Machinery.—Dy. cap., 750,000 galls.; Blake dup., comp., cond., with 9 and 16-in., steam, 9½" water cylinders, 12-in. stroke. *Boilers:* Blake, horizontal, tubular, 4½ x 13 ft.

Force Main.—Diam., 8 ins. to point of distribution, 10 ins. thence to stand, pipe.

Stand-Pipe.—Cap., 205,000 galls.; 20 x 90 ft.; w. i., ¾ ins. thick for bottom, and first 20 ft., ½ and 7-16 for two succeeding 20 ft., 5-16 and ¼ for two succeeding 15 ft. Factor of safety increases quite uniformly from 4.15 at bottom to 9.78 at top. Contrs., E. Hodge & Co., East Boston, Mass.

Distribution.—(Jan. 1, '90.) *Mains,* 10 to 4-in. c. i., 1.8 miles; to be increased to 4 miles. *Services,* ¾-in. w. i. and cem. Pipe and specials from Gloucester Iron Works, Philadelphia, Pa.; trenching and pipe-laying done by R. I. Davidson, Abington, and by town. *Taps,* 31. *Meters,* not given. *Hydrants,* Ludlow, 13; to be 30. *Valves,* Ludlow. *Pressure:* ordinary, 75 lbs.; fire, 125 lbs.

Financial.—(Jan. 1, '90) Cost, $23,039. Cash in hand, $7,866. Bonded debt, $30,000. Int., 4%, semi annually, Mar. and Sept. Bonds dated Sept. 2, '89; $500 a year, payable first 10, $1,000 next 10, $1,500 a year third ten years; sold at 101½.

Management —Three Comrs. Chn. and Secy., C. H. Felker. Treas., Nathan Tucker.

AYER, *Middlesex Co.* (Pop., 1.881; est., 2.500.) Has various manufactories. Not incorp. No sewers or electric lights.

History.—Built in '88 by town. Engr., Percy M. Blake, Hyde Park.

Water Supply.—Collecting well, pumping to reservoir. Well is 26 ft. in diam. by 25.6 ft. deep.

Reservoir.—Oval, 13 ft. deep.

Pumping Machinery.—Dy. cap., 480,000 galls.; Davidson.

Reservoir. - Cap., 100,000 galls. Contr., J. R. Rook, Framingham.

Distribution.—*Mains,* c. i., 5.35 miles. *Services,* enam. l. Pipe furnished by R. D. Wood & Co., Philadelphia, Pa., and laid by C. W. Talcott, Woonsocket, R. I. *Taps,* 197. *Meters,* 5. *Hydrants,* Ludlow, 43. *Valves,* Ludlow.

Consumption, 40,000 galls. *Pressure,* 65 lbs.

Financial.—Cost, $63,000. Debt, $63,000. Int., 4%. Sinking fund, $500. Ann. op. exp.. $700. Ann. rev.: consumers, $1,600; city, $2,350. Hydrant rental, $50.

Management.—Comrs. Chn., Andrew Atwood. Clerk, J. R. Gray.

BELMONT, *Middlesex Co.* (Pop., of township, 1,565; in '85, 1,639.) No sewers. Has electric lights.

History.—Built in '87 by town. Engr., E. A. W. Hammatt, with M. M. Tidd as Consulting Engr., both of Boston, Mass.

Water Supply.—From works of Watertown Water Supply Co., under a 5-years contract.

Distribution.—*Mains,* c. i., 7 miles; from Donaldson Iron Co , Emaus, Pa , and originally laid by Jno. T. Langford, Boston; pipe extensions in '88 laid by H. H. Pike. Specials from Builders' Iron Foundry, Providence, R. I. *Taps,* 108. *Hydrants,* Coffin, 54. *Valves,* Coffin.

Financial.—Cost, $44,124. Debt, $41,250, "in notes maturing a part each year." Int., 4%. Ann. op exp., withheld, est., $1,000. Ann. rev.: consumers. $1,200: city, $1,000. Hydrant rental, $17.50.

Management.—Comrs.: W. J. Underwood, T. D. Blake, G C. Holt.

BEVERLY, *Essex Co.* (Pop., 8,456; est , 10,000.) Engaged in commerce and manufacturing shoes and fishing tackle. Has electric lights.

History.—Supplied from Salem, '69–'87, town owning distribution system. In '87, town completed reservoir and pumping station for its own use. Des. Engr., Clemens Herschel. Const. Engr., Walter H. Sears.

Water Supply.—Wenham lake, direct pumping and pumping to reservoir.

Pumping Machinery.—Dy. cap., 4,000,000 galls.; 2,000,000 Gaskill pump added in '88

Reservoir.—Cap., 3,200,000 galls.; 174 ft. above tide. Contrs., Hill, Ellingwood & Frances, Lowell.

Distribution.—*Mains*, 20 to 4-in. cem.-lined w. i. and steel, 50 miles. *Services*, galv. i. Pipe furnished and laid by New England Construction, Boston. *Taps*, 2,150. *Meters*, 50. *Hydrants*, Coffin, 162. *Valves*, Coffin.

Consumption, 1,000,000 galls. *Pressure*, 60 lbs.

Financial.—Cost withheld. est., $450,000. Ann. op. exp., $17,000. Ann. rev.: consumers, $22,350. No other data.

Management.—Water Board: Supt., Chas. Pickett.

NOTE.—Officials furnished no figures for '88, saying information was nearly same as for '87.

BOSTON, *Suffolk Co.* (Pop., 362,839; in '85, 390,393: est., 400,000. Total pop. supplied, est., 476,000; of this, 370,000 is supplied by Sudbury and Cochituate, and 106,000 by Mystic system.) On west side of Massachusetts Bay at mouth of Charles River. Settled in 1630. Incorp. city in '22. Has sewers and electric lights. Old city was on peninsula about 2¾ miles long, 1 mile broad at its widest point, 150 ft. at its narrowest, and with area of 783 acres. Four-fifths of old city is on ground less than 20 ft. above tide-level, while Beacon hill has elevation of about 100, and Copp's hill 50 ft. Area of old city, or Boston proper, has been increased, by filling in ancient coves and water-ways, to 1,829 acres, while total area of city has been increased to 36.7 sq. m. by annexation of East Boston, South Boston, Roxbury, Dorchester, West Roxbury, Charlestown, Brighton, Breed's Island and Deer's Island.

History.—Present water supply was introduced by city in '48, '64 and '78.

In 1652 the "Water-Works Company" was incorp. for building "the conduit," which was a reservoir about 12 ft. sq., located near present Dock Square, to which water was conveyed by wooden pipes from neighboring springs and used for domestic and fire purposes. No further steps toward water-supply seem to have been taken until June 10, 1796, when "The Aqueduct Corporation" was incorp. with cap. of $130,000, to bring water into town from Jamaica pond, in Roxbury. This Co. had 4 mains of pitch-pine logs, two of 4-in. and two of 3-in. bore; distribution pipes were also of wood with 1½-in bore.

First public supply of importance was introduced Oct. 25, 1848, from Lake Cochituate. This was increased in '78 by additional supply from Sudbury river, while by annexation of Charlestown, in '74, Boston came into possession of Mystic Water-Works which had been built in '64, and also supply Chelsea, Everett and Somerville.

For Cochituate works, Consulting Engr. was Jno. B. Jervis and Const. Engrs. were Wm. S. Whitwell and E. S. Chesborough. A. Fteley was Engr. in charge of const. of Sudbury extension, under Jos. P. Davis, City Engr. of Boston. Engr. of Mystic works was C. L. Stevenson.

THE COCHITUATE AND SUDBURY DEPARTMENT.

Lake Cochituate Supply.—By gravity from lake about 17 miles west of Boston, with pumping for high-service; has water surface of 800 acres, a total cap. of 2,011,000,000 galls., elevation of 134.36 ft. above "tide-marsh level" at high-water mark, and drainage area of 18 sq. m. When drawn down 10 ft., or to level of flow line of conduit, surface area of lake is but 489 acres. Lake is in three natural basins, connected by narrow channels, in lower of which provision is made for shutting off water by stop planks, thus retaining water of two upper basins in case repairs are needed to dams. Pipes connect Dug pond, area, 44.5 acres, elevation, 141.36 ft., and Dudley pond, area 81 acres, elevation, 146.46 ft., with supply of lake. Pegan brook, flowing through village of Natick, discharged offensive matter into lake, and in '63 filter dams of coarse stone, with 3 ft. of pebbles in the center, were built at its mouth. Sewage has since been taken out through process of law.

Dams.—At outlet of lake are two stone masonry dams, 500 ft. apart. First dam was on quicksand, and after filling lake springs boiled up below it, carrying sand. This necessitated second dam, which was protected from like fate by a line of 8-in. tongued and grooved sheet-piling driven 15 to 20 ft. in the gravel. A substantial stone dam is now in process of construction to take the place of these old dams.

Cochituate Conduit.—From Lake Cochituate to Brookline reservoir, 14 6 miles long. Oviform, with large end down, 6.33 ft. high and 5 ft. wide. Of brick, 8 ins. thick, plastered outside from top to spring of invert. It rests on earth throughout, foundation on embankments being puddled. It is generally in excavation. Has cuts of over 30 ft. and two tunnels. The gradient is about 3 ins. a mile except at crossing of Charles river, which is by inverted siphons of c. i. pipes, two of 30-in. and one each of 36 and 40-in. pipes, for 1,095 ft., with fall of 0.52 ft. between ends. Approaching river, the conduit is carried on puddled embankment 40 ft. high to river. The siphon pipes cross river on granite bridge, pipes being 52 ft. lower than ordinary grade line of conduit.

Brookline Reservoir.—Cap , 120,000,000 galls. At termination of old conduit; area, 23 acres; depth, 12 to 24 ft.; when full is 124.6 ft. above tide-level.

Chestnut Hill Reservoir.—Cap., 700,000,000 galls. Built from '65 to '70. About 1 mile west of Brookline reservoir, with which it is connected by the Cochituate conduit. Elevation, 124 ft. above tide-level. It is irregular in shape and is divided into two basins by water-tight dam having gate chamber so arranged that either basin can be emptied.

Nearly one-half total area of Boston is above level which can be supplied by gravity from Chestnut hill or Brookline reservoirs. To supply these high levels water is pumped to distributing reservoirs on Fisher and Parker hills, and repumped from former reservoir to tank in West Roxbury. Water is also pumped to tank for East Boston and Breeds I land high service.

Chestnut Hill Pumping Machinery.—Dy. cap., 16,000,000 galls., with repumping cap. of 2,700,000 galls.; two 8,000,000 Gaskill horizontal, pumping from Chestnut hill to Fisher, and Parker hill reservoir; two 400,000 Knowles re-pumping from Fisher hill reservoir to West Roxbury tank ; two 750,000 and one 400,000 Worthington, pumping to East Boston and Breeds Island tank.

Fisher Hill High Service Reservoir.—Cap., 15,000,000 galls. In Brookline, 4 miles from Boston, 241 ft. above tide-level. Filled by pumps at Chestnut hill reservoir, one mile distant.

Parker's Hill High Service Reservoir.—Cap., 7,200,000 galls. In Boston, 219 ft. above tide-level; filled through 30 and 24-in. main from Fisher Hill reservoir.

South Boston, East Boston and Deer's Island have each been supplied by laying mains across rivers.

West Roxbury Tank.—Cap., 125,000 galls.; w. i., 24x40 ft.; 365 ft. above tide marsh level.

East Boston and Breeds Island Tank.—Cap., 125,000 galls.; w. i., 24x40 ft.; elevation, 154.6 ft. above water-works base.

Sudbury River Supply.—Brought from Sudbury river to Farm pond, in Framingham, and thence to Chestnut hill reservoir described above. River has a drainage area of 76 sq. m. and a minimum dy. yield of 40,000,000 galls.

Storage Reservoirs.—Combined cap., 3,200,000,000 galls. Three dams at confluence of two streams form as many reservoirs, water from any one of which can be drawn immediately to conduit leading to Farm pond. *Dams:* earth, with heart-walls and overflows of stone masonry. The first 3 reservoirs or basins have storage cap. of 1,800,000,000 galls.; a fourth basin, constructed '81-6, holds 1,405,000,000 galls. Area, 162 acres. Plans are under way for a fifth basin of about same cap as No. 1.

Sudbury Conduit.—To Farm pond, natural lake of 200 acres, 4,170 ft., and from thence to Chestnut hill reservoir, about 16 miles, with grade of 1,056 ft. per mile. The conduit is of brick, oviform, has sectional area of 56.75 sq. ft., with concrete foundation and side walls and spandrel backing of rubble-stone masonry. When above natural surface conduit rests upon embankments of selected earth. Charles river is crossed on granite bridge 475 ft. long and 75 ft. high, and Waban valley by granite bridge 536 ft. long and 40 ft. high, with 9 arches. On bridges, inside of conduit is lined with cement, and spaces for drainage are left in side walls of bridges

Arrangements for measuring flow of water are made at certain points along conduit, and since its completion the most accurate measurements ever made of the flow of water in large masonry conduits have been conducted by A. Fteley, the engineer in immediate charge of construction of these works (See references below.)

Sudbury and Cochituate Distribution.—*Mains*, c. i., 456.6 miles. *Services*, lead. *Taps*, 56,917. *Meters*, 3,133, of which 1,448 are Crown, 1,030 Worthington, 80 Tremont, 507 "B. W. W.," and remainder Ball & Fitts, Desper, Balance Valve, Hersey, Star, Frost, etc. *Hydrants*, Post & Lowry, 5,008. *Stop-gates*, 4,882.

Consumption, 33,500,000 galls. *Pressure*, 35 to 75 lbs.

Financial.—Cost, $20,049,615. Debt, $14,941,274. Int., 3½ to 6%. Sinking fund, $4,738,894. Ann. op. exp., $381,638. Interest, $735,791. Ann. rev.: consumers, $1,317,385; city, $117,347; hydrant rental, $18.

COCHITUATE DEPARTMENT:—DISTRIBUTION AND FINANCIAL STATISTICS AT CLOSE OF THE YEARS '60, '70, '80, '87 AND '88.

Year.	Miles of mains.	Taps.	Meters.	Hydrants.	Cost.	Total revenue.
'60	129.7	23,245	*100	1,415	$5,661,072	$334,545
'70	170	30,471	1,076	1,984	9,341,909	708,784
'80	384.5	46,315	1,219	4,204	16,750,518	1,039,897
'87	436.5	55,285	3,114	4,900	19,527,483	1,475,298
'88	456.6	56,947	3,133	5,008	20,049,615	1,431,732

*About.

THE MYSTIC DEPARTMENT.

Supplies cities of Chelsea and Somerville and town of Everett, outside Boston.

Mystic Lake Supply.—Water is conveyed by gravity to pumping station and thence is pumped to Walnut hill reservoir. Lake is 6½ miles from Charlestown, in the "towns" of Medford, Arlington and Winchester; cap., 330,000,000 galls.; area, about 200 acres; drainage area, 27¾ sq. m.; surface elevation, only 7 ft. above tide level.

Dam.—Was built across narrow portion of lake, 1,560 ft. long and carried 11 ft. above high-water mark; earth, on piling and puddle, lined on each slope with puddle and riprap; has overfall of granite masonry, and large plank fish-way.

Mystic Conduit.—To pumping station from gate-house at dam; extends along north branch of Mystic river for 7,453 ft. to a pipe-chamber, from which it crosses the river to the pump-well. The conduit to the river is of brick, oviform, 5.67 ft. high and 5 ft. wide, the base being a 5-ft. semicircle. River is crossed by iron pipes.

Pumping Machinery.—Cap., 18,000,000 galls.; two 5,000,000, and one 8,000,000 Worthington.

Walnut Hill Reservoir.—Cap., 26,244,000 galls. Serves as receiving and distributing reservoir and is situated so that it can supply any of the towns between the Charles and northern slope of the Mystic river. At present it supplies the Charlestown district and the towns of Chelsea, Everett and Somerville. High-water elevation, 147 ft. above tide-level; area, 4½ acres; depth, 26 ft.; inner slopes, 1½ to 1; lined with 2 ft. of puddle covered with 8 ins. of brick work. Bottom, puddle, covered with 8 ins. of concrete.

Mystic Distribution.—*Mains*, c. i., w. i. and cem., 141.5 miles. *Services*, lead. *Taps*, 17,697. *Meters*, 387: Worthington, Crown, Tremont, Ball & Fitts, "B. W. W." and Star. *Hydrants*, Lowry, 956.

Consumption, 8,258,400 galls. *Pressure*, 50 lbs.

Financial.—Cost, $1,630,757. Debt, $839,000. Int., 3½ and 6%. Sinking fund, $704,041. Ann. op. exp., $162,086. Int., $11,993. Ann. rev.: consumers, $293,056, of which $89,789 was refunded to Chelsea, Everett and Somerville; city, $15,511. Hydrant rental, $18.

WHOLE WORKS.

Management.—Water Board of three. City Engr. and Chf. Engr. of Board, Wm. Jackson. Rest. Engr., Additional Supply and Supt. Western Division Cochituate Dept., Desmond Fitz Gerald. Supt. Eastern Division Cochituate Dept., Dexter Brackett. Supt. Mystic Dept., Eugene S. Sullivan. Water Registrar, Wm. F. Davis. Supt. Meters, Wm. J. Welch. Supt. Inspection and Waste, P. B. Cashman.

References.—In addition to list of papers and articles given in MANUAL for '88, valuable information relating to Boston Water-Works may be found as follows:

"History of the Boston Water-Works," 1868. By N. J. Bradlee. Do., 1876. By Desmond Fitz Gerald.

"Report on the Capacity of the Sudbury River and Cochituate Watershed in Time of Drought." By Desmond Fitz Gerald.

"Rainfall Received and Collected on the Watersheds of Sudbury River and Cochituate and Mystic Lakes, from '63 to '85." With Tables and Diagrams. By Dexter Brackett. Journal Assn. of Eng. Soc., Sept., '86.

"Experiments Made with the Deacon Waste Water Meter System. With numerous diagrams and tables. By Dexter Brackett. Journal Assn. Eng. Soc. May, '82.

"The Distribution System of the Boston Water-Works." A detailed description of system, appliances used, cost of pipe-laying, etc. With plates. By Dexter Brackett. Journal Assn. Eng. Soc., Feb., '86.

"High Service Systems of the Boston Water-Works." A very complete and detailed description. By Jno. A. Gould, Jr., Journal Assn. Eng. Soc., Sept. '89.

Tenth Census of U. S., vol. xvii., Water Supply of Cities, pp. 17 to 31.

BRADFORD, *Essex Co.* (Pop., town, 2,643.)

NOTE.—Latter part of '89 contracts were let for 1,000,000-gall. comp., cond. Worthington pump.

BRAINTREE, *Norfolk Co.* (Pop., 3,855; est., 4,500.) In agricultural and manufacturing district, 10 miles from Boston. Incorp. town. No sewers or electric lights.

History.—Built in '87 by Braintree Water Supply Co. Engr., Wm. Wheeler, Boston. Contrs., Wheeler & Parks, Boston. Town has voted to buy the works, but had not taken possession Aug. 1, '89.

Water Supply.—Filter gallery, pumping to stand-pipe.

Filter Gallery.—Stone walls, arched over with brick; 15 x 15 ft., x 16 ft. deep.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two 1,000,000 Blake. *Boilers,* from E. Hodge & Co., E. Boston.

Stand-Pipe.—Cap., 528,700 galls.; 30 x 100 ft.; from Edw. Kendall & Son, Cambridgeport.

Distribution.—*Mains,* 12 to 4-in. c. i., 12 miles. *Services,* ¾-in., enam. i. Pipe from Warren Foundry & Machine Co., Phillipsburgh, N. J.; specials from Builders Iron Foundry, Providence, R. I.; trenching and pipe-laying done by Ferris & Halladay, Jersey City, N. J. *Taps,* 360. *Meters,* 15. *Hydrants,* Coffin, 100. *Valves,* Coffin.

Consumption, 125,000 galls. *Pressure,* 80 lbs.

Financial.—Cost, $180,000. Cap. stock, $100,000. Bonded debt, $90,000. Ann. op. exp., $2,300. Ann. int., $4,500. Ann. rev.: consumers, about $5,000. Int., 5%. Hydrant rental, free.

Management.—Prest., Elisha Thayer. Treas., Jno. H. Chapman, Boston. Clerk, Jno. Mulhall, Boston. Supt., M. C. French.

BRIDGEWATER and EAST BRIDGEWATER, *Plymouth Co.* (Pop.: Bridgewater, 3,620; est., 4,000. East Bridgewater, 2,710; est., 3,000.) Engaged in manufacturing iron, brass and cotton goods. Incorp. No sewers or electric lights.

History.—Built in '87 by National Water-Works Syndicate, Boston. Engr., Geo. Alexander, Boston. In '89, comrs. were appointed by the two towns to consider purchase of works.

Water Supply.—Two wells in Bridgewater, near Tom's river, pumping to stand-pipe. One well is 25 x 60 ft. x 22 ft. deep, with semi-circular ends, other 22 ft. in diam. and depth; each excavated 1 ft. below ordinary river level.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; Worthington; about midway between the towns.

Stand Pipe.—Cap., about 270,000 galls.; 25 x 75 ft.; open at top.

Distribution.—*Mains,* c. i., 22½ miles. *Services,* rustless w. i. *Taps,* 500. *Meters,* none *Hydrants,* kind not given, 60. *Valves,* Ludlow.

Consumption, 300,000 galls. *Pressure,* 80 lbs.

Financial.—Cost, $150,000. Cap. stock, $100,000. Bonded debt, $100,000. Int., 5%. Sinking Fund, 20% of each year's net revenue. Ann. op. exp., $1,800. Ann. rev.: consumers, $6,000; city, $1,800. Hydrant rental, $30.

Management.—Prest., B. W. Harris. Secy., R. O. Harris. Treas., Isaac N. Mutter. Supt., H. H. Thorndyke.

BROCKTON, *Plymouth Co.* (Pop. 13,608; est., 23,000.) Manufactures boots and shoes. Settled in 1700; incorp. city in '81. No sewers. Has electric lights.

History.—Built in '80-1 by town. Engr., Phineas Ball, Worcester. In '70 a fire protection plant was put in, having No. 7 Knowles pump, reservoir, ¼ mile of pipe and 7 hydrants. In '77 2½ miles of pipe were added, at cost of $33,509.

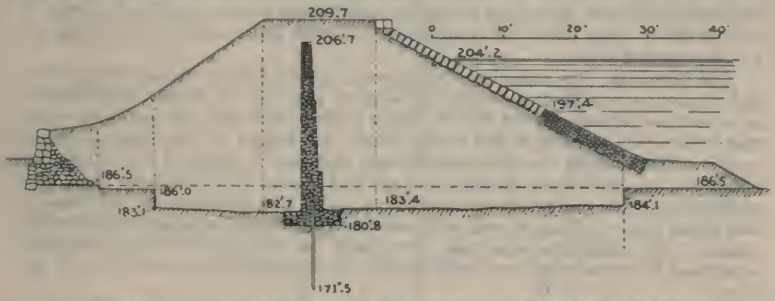
Water Supply.—Salisbury brook, by gravity from impounding reservoir.

Dam.—Earth, with heart-wall; length on crest, 1,524 ft.; greatest height above natural service, 23.2 ft.; top width, 16 ft.; inner slope, 2 to 1, outer, 1½ to 1; normal depth of water at dam, 17.7 ft. Clayey gravel, up-stream side puddled in 18-in. layers, and two-thirds of slope, from top down paved with common stone averaging 18 ins. in diam.; paving capped with granite 1 ft. thick by 2½ ft. wide; lower third of inner slope covered with small stone to depth of about 2 ft. Down-stream side puddled about half-way up slope, then built up in 3-ft. layers; retaining wall at toe. *Heart-wall:* Rubble concrete, rammed; 3 ft. thick at bottom, stepped to 1½ ft. at top; top within 3 ft. of top of dam, and bottom carried about 2 ft. below bottom of embankment and about 6 ft. below natural surface. Has pilasters about 8 ins. wide, some 5 ft. apart. Earth beneath dam was excavated to solid gravel bottom, save

about 150 ft. in center along length of dam, where clean washed sand was found; here a row of 4-in. spruce sheet-piling was driven to depth of from 3 to 16 ft. *Spillway:* Masonry, at extreme end of dam, 24 ft. wide, with top of sill 1 ft. below normal high-water and flash-board 1 ft. high; has rubble concrete foundation, and slope of about 4 to 1. *Discharge and Waste-pipes:* Former 30 ins. in diam., extending through dam; laid in solid concrete; connects with 24-in. supply main, but has 30-in. waste-gate. Waste-pipe is 12 ins. in diam., connecting directly with reservoir, and laid beside discharge-pipe. Both pipes draw water from bottom of pond, and normal depth of water in gate-house is 14 ft. See accompanying cross-section. For area flooded, cap., etc., see reservoir, below. "No signs of leakage." Built in '80-1. Engr., Phineas Ball, Worcester. Assist. Engr., E. L. Brown, Brockton. Contrs., J. W. Brown & Co., Providence, R. I. Cost, about $50,000.

Reservoir.—Cap., about 330,000,000 galls.; area, about 90 acres; formed by above dam. Is 3 miles from and 122 to 18 ft. above city.

Filter.—*Not in use*, owing to water from it being impregnated with iron. A portion of bottom of reservoir was prepared for filtering by laying 4-in. drain tiles 30 ins. below surface and 8 ft. apart. This area covers 55,000 sq. ft. A chamber 750 ft.



Cross-Section of Dam on Salisbury Brook, Brockton, Mass.

from dam contains conduit 3½ ft. wide and 4 ft. high, having side walls and arched top of rubble and concrete. It was intended to convey water from filter through this conduit to supply pipe, but up to '83 this had not been done.

Distribution.—*Mains*, c. i., w. i. and cem., 34.2 miles. *Services*, w. i. and cem. *Taps*, 2,450. *Meters*, 1,283. *Hydrants*, Ludlow, 306. *Valves*, Ludlow.

Consumption, about 1,000,000 galls. *Pressure*, 45 lbs.

Financial.—Cost, $452,803. Bonded debt, $405,000: $120,000 at 5, $220,000 at 4, and $65,000 at 3½ %. Sinking fund, $69,972. Ann. op. exp., about $3,700. Ann. rev.: consumers, 26,826; city, $3,000.

Management.—Three comrs.: Prest., E. H. Reynolds; Secy. and Treas., F. B. Gardner; Supt., Walter F. Cleaveland.

BROOKFIELD, *Worcester Co.* (Pop. 2,820; est., 3,000.) In farming country and has large boot factories and cotton mills. Not incorp. No sewers or electric lights.

History.—Built in '88-89 by town. Engr., A. C. Moore. Contrs., McBride & Hennessey, Boston.

Water Supply.—Springs, by gravity.

Reservoir.—Cap., not given; area, ¾ acres.

Distribution.—*Mains*, 12 to 6-in. i., 1¾ miles. *Taps*, none Jan. 1, '89; 10, June 24, '89. *Meters*, none. *Hydrants*, kind not given, 9. *Valves*, Chapman.

Consumption, not determined. *Pressure*, 50 lbs.

Financial.—Cost, about $17,000. Debt, $16,000. Int. 4%. Other data not determined.

Management.—Three Comrs. Report by Comr. C. B. Carpenter. Supt., H. L. Smith.

BROOKLINE, *Norfolk Co.* (Pop., 8,057: est., 10,500.) On Charles river and small tidal estuary called Muddy river, opposite Boston. It comprises 200 acres of salt marsh, 500 acres of plain of river gravel rising to about 100 ft. above tide, and hills of glacial drift rising from 300 ft. to 500 ft. above tide. Settled in 1634 and incorp. in 1705. Has sewers and electric lights.

History.—Built in '75 by town. Engr., Edw. S. Philbrick. Consulting Engr. for high-service, M. M. Tidd, Boston.

Filter Supply.—Filtered from Charles river, and pumped to reservoir and tank. Water is taken 6 miles from center of town on Cow island, from a ridge of gravel surrounded by marshes, along side Charles river.

Filter Gallery.—From 100 to 300 ft. from river, in clean, coarse sand and gravel, with bottom 6 ft. below lowest stage of river; 4 ft. wide, with vertical side walls 2 ft. high of uncemented rubble stone, covered by an 8-in. semicircular brick arch. Owing to peat bog, from which it was not desirable to take water, gallery is in two sections, one 451 ft., and one 271 ft. long. These were originally connected by 389 ft. of 24-in. stone-ware pipe, with cemented joints. In '78 an addition was made to one of the galleries, 160½ ft. long, 6 ft. wide, and 6 ft. high in center. Weirs are so arranged that water can be drawn to filters directly from river in cases of great emergency, but this has not yet been necessary. The addition was buil t after plans made by Shedd & Sawyer, of Boston, who found that 460 ft. of longer gallery had been rendered useless by fall of 18 ft. of arch, so that gallery was full of debris In '75, when galleries were first constructed, the av. dy. yield was est. as 850,000 galls. In '80, with new gallery, and pumps set at a lower level, the yield was 1,000,000 galls. a day, while the dy. consumption was about 800,000 galls. The yield was somewhat increased by cutting a canal parallel to and connected with the weir by shut-off gates. This canal was from 50 to 150 ft. from gallery, about 150 ft. long, and 3 ft. below river level.

Old Conduit.—The pumping station was originally 3,074 ft. from filter galleries, and connection was made by a 25-in. stone-ware pipe laid on timber foundation in saturated gravel and sand 6½ to 10 ft. below surface of swamp. It was soon found that 10 per cent. of the pipes had broken under the weight of the superincumbent gravel. This conduit was then removed and replaced by flume of 3-in white pine plank, 2 ft. sq., inside, with tongued and grooved joints, In about three years complaints were made regarding the impurity of water, and on examining the flume it was found that wood had shrunk and was admitting swamp water and sand through joints. The pumping station was moved near to filter galleries and connected with them by the new gallery mentioned above, thus doing away with the old conduit.

Pumping Machinery.—Dy. cap., 3,500,000 galls.; 2,000,000 Worthington for low- and 1.500,000 Blake for high-service.

Force Main.—Is 2¼ miles long; in '80 dimensions were 16 and 14 ins.

Reservoir.—Cap., 6,000,000 galls. On Fisher's hill for low-service supply. Is 360 x 130 ft. x 20 ft. deep. Excavation and embankment, with bottom covered with 12 ins. of puddle and 4 ins. of gravel concrete, and the slopes with 18 ins. of clay puddle and 12 ins. of broken stone, against which was laid a 15-in. dry stone slope wall. During construction springs in gravel banks gave trouble by softening the puddle. This was obviated by making pockets of broken stone and leading spring water through puddle by gas pipes; these pipes were plugged after work was completed.

Tank.—Cap., 450,000 galls.; 50 x 30 ft.; iron, painted inside and roofed over.

Distribution.—*Mains*, 24 to 4 in. c. i., 40 miles. *Services*, w. i. and cem., enam. i., lead. *Taps*, 1,631. *Meters*, 475. *Hydrants*, Carr, 258. *Valves*, Chapman, Whittier. *At close of* '80: Mains, 25 miles. Taps, 910. Meters, none. Hydrants, 151.

Consumption, 835,338 galls. *Pressure*, 30 to 100 lbs.

Financial.—Cost to Feb. 1, '89, $802,703. Bonded debt, $651,000: $400,000 at 7, $75,000 at 6, $67,000 at 5, $49,000 at 4½, '$60,000 at 3.65%. Sinking fund, $332,516. Ann. op. exp., $15,000. Ann. rev.: consumers, $21,536; city, $11,369. Hydrant rental, $24.50. First cost, $475,000; to Dec. 31, '80, $591,190.

Management.—Water Board of 3. Chn., Wm. K. Melcher. Clerk and Registrar, Francis Hunnewell. Supt., F. F. Forbes.

Reference.—Tenth Census, U. S., Vol. XVII., Water Supply of Cities, p. 243.

CAMBRIDGE, *Middlesex Co.* (Pop., 52,699; est., 65,000.) Separated from Boston by Charles river. Founded in 1630. Incorp. Has sewers and electric lights.

CAMBRIDGEPORT AQUEDUCT CO.

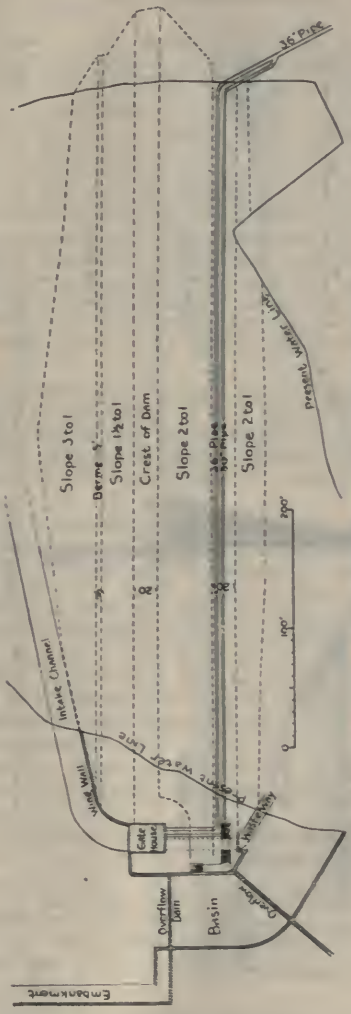
General Description.—Chartered in '37, and supplied few families through logs with 3-in. bore, conveying water from springs in Somerville to reservoir in eastern part of Cambridge, then known as Lowerport. This reservoir was 40½ x 20½ ft., depth unknown, and was 27 ft. below springs.

PRESENT WORKS.

History.—Built in '55 by a corporation known as Cambridge Water-Works, when pop. was about 20,000. Consult. Engr., Jno. H. Blake, Jersey City, N. J. Contr., Gardner Warren. Works were purchased by city in '65.

Water Supply.—Fresh pond in Cambridge and Stony brook in Waltham, by pumping to reservoir and stand-pipe. The Stony brook system was completed in '87.

The drainage area of Fresh pond is 569 acres, and at high water pond has an area of 183 acres. Pond is capable of supplying 1,500,000 galls. per day in dry weather. Stony brook receives drainage from 23.6 sq. m. Its source is Sandy pond, and its basin is connected with Fresh pond by 7 miles of pipe. Dam on Stony brook is towns of Weston and Waltham, ½ in each.



Plan of Stony Brook Dam, Cambridge, Mass.

In '76 an attempt was made to obtain additional supply by laying conduit of wood and brick, with sectional area of 10.65 sq. ft. and length of 4,061 ft. to Spy pond, Little pond and Wellington brook. This extension is said to have cost $80,000, but, owing to pollution of water from Spy pond and Wellington brook this supply could be used but little while each year, and has been abandoned. In '80 a pipe was laid across Charles river to connect with the Cochituate department of the Boston water-works, but it was found that no water could be spared, and the pipe has never been used.

Filter.—At one time a filter was in use; gravel, 40 x 50 ft.; no cleaning.

Stony Brook Dam and Reservoir.—Cap., 350,000,000 galls.; area, about 72 acres. Dam is of selected gravel, puddled and rolled, with heart-wall; 706 ft. long on crest, with wing embankment about 200 ft. long; 25 ft. high, above natural surface of water, 20 ft. wide on top; raises water 20 ft., within 5 ft. of top. *Heart-wall:* grouted masonry, 8 ft. wide at bottom, 3 at top, coming within about 3½ ft. of top of

Cross-Section of Stony Brook Dam, Cambridge, Mass.

dam; foundation 12 ft. wide by about 4 ft. deep; concrete extends up inner side to natural bed of stream, being packed about top of 30-ft. sheet-piling. Foundation rests upon stratum of fine sand beneath that of blue gravel, and piling extends 35 ft. beneath bottom of main dam and 25 ft. below concrete foundation of heart-wall. *Spillway:* at west end of dam; excavated in rock to a width of 60 ft., with overflow dam at entrance, 40 ft. wide; depth and slope, not given, but from drawings appear to be sufficient. *Gate-house:* between dam and spillway, about 25 x 30 ft., with 5 x 6-ft. gate. *Discharge culvert:* 5¾ x 13 ft., leading from gate-house to foot of

outer slope. *Discharge-pipes:* two, a 30 and 36-in., joined to 36-in. supply main Pipes extend from from gate-house to berme, beneath berme to other end of dam, then down the valley. Top of pipes are a little below natural level of stream, and about 20 ft. below high-water in reservoir. The 36-in. pipe can be discharged into the river. See accompanying plan and section. Dam leaks a little at one end through original bank. Built in '85-7. Des. Engr., Wm. S. Barbour. Const. Engr., N. Henry Crafts, Boston. Contrs., H. H. Pike & Son, Cambridgeport. Cost, including clearing natural surface of reservoir, building dam and gate-house, and all attendant expenses, about $259,000.

Pumping Machinery.—Cap., 21,000,000 galls.; of this 12,440,000 galls. are Worthington and the remainder Blake. In '55 two 720,000 Worthington pumps were put in, and in '68 and again in '74 a 5,000,000 Worthington was added.

Reservoir.—Cap., 5,375,321 galls. The original size has been increased, the dimensions now being 340 x 170 ft. x 15.13 ft. deep. Bottom and sides are of clay puddling, 20 ins. thick, covered with 4 ins. of concrete. Inner slopes are 1.3 to 1, paved with cement-laid granite blocks, 8 ins. thick; coping is 3. ft. high by 2 ft. wide. Reservoir is divided in two parts by partition wall 3 ft. lower than coping, there really being two reservoirs constructed at different dates, and each having separate supply pipes. Outside of coping is embankment and retaining wall; former is 7 ft. wide on top, having 3 ft. of walk and 4 ft. of sodding; sodded slope of embankment is 1.25 to 1, and extends to retaining wall, which is 8.37 ft. below reservoir coping, has average width of 7 ft. and height ranging from 6.5 to 23 ft. Distance from outside of reservoir coping to outside of retaining wall coping is uniformly 23 ft. Top of reservoir coping is 86.35 ft. above mean low tide and 35.19 ft. above high water in Fresh pond.

Stand-Pipe.—Cap., about 9,000 galls.; 5.42x54 ft.; near reservoir, equalizes pressure in mains. Made by Campbell Bros. It is of riveted boiler iron, has overflow 130 ft. above mean tide level and 79 ft. above high water in Fresh pond; rests on granite foundation and is protected by circular building of granite, brick and wood, 13 ft. in outside diameter at bottom and 10 ft. at top, having spiral staircase inside and landing on top.

Distribution.—*Mains*, 24 to 4-in. c. i., w. i. and cem., about 100 miles; w. i. and cem. pipe from Ferris & Halladay, Jersey City, N. J., formerly American Water Works & Gas Pipe Co. *Services*, galv. i. *Taps*, 9,730. *Meters*, 221. *Hydrants*, Chapman, Whittier, Coffin, 617. *Valves*, kind, do. *Taps*, close of '70, 4,191; of '80, 7,322. *Meters*, close of '70, 68; of '80, 156. *Hydrants*, close of 80, 579.

Consumption, about 4,000,000 galls. *Pressure:* Ordinary, 28 lbs. Fire, 48 lbs.

Financial.—Cost, $2,539,780. Debt, $1,723,500. Int., 3½ to 6%. Sinking fund, $753,942. Ann. op. exp., $41,951. Ann. rev.: consumers, $212,000. Original cost, $291,480; cost to Dec. 31, '70, $885,007; to Dec. 31, '80, $1,721,831. Revenue for '70, $92,607; for '80, $208,111. Since '80 several reductions have been made in rates, which accounts for small increase in revenue.

Management.—Seven Comrs. Prest., C. W. Kingsley, No. Cambridge. Clerk, W. H. Harding, Cambridgeport. Supt., Hiram Nevons, Cambridgeport. City Engr., L. M. Hastings.

NOTE.—For more detailed account see *Eng. News*, vol. V., p. 146; vol. VIII., p. 264. Also Tenth Census U. S., vol. XVII., Water Supply of Cities, pp. 243-4.

CANTON, *Norfolk Co.* (Pop., 4,516; est., 5,000.) In farming country, 15 miles from Boston. Manufactures shovels, stove-polish, copper, cotton and woolen goods. Incorp. town. No sewers. Experimenting with electric lights.

History.—Built in '88-9 by town; put in operation Feb., '89. Engr., Wm. Wheeler, 89 State St., Boston.

Water Supply.—Filter well, pumping to stand-pipe. Well is 40 ft. in diam., 28 ft. deep, lined with brick in cem.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two 1,000,000 Knowles comp. dup., with 9-in. high and 18-in. low-pressure steam, and 10-in. water cylinders, of 18-in. stroke. *Boilers:* Two 100-H. P. Whittier.

Stand-Pipe.—Cap., 467,600 galls.; 35x65 ft.; from Robinson Boiler Works.

Distribution.—*Mains*, 12 to 4-in. c. i., 14 miles. *Services*, ¾-in. enam. i. Pipe from McNeal Pipe & Foundry Co., Burlington, N. J.; specials from Builders' Iron Foundry, Providence, R. I. Trenching and pipe-laying done by C. H. Eglee. Flush

ing, N. Y. *Taps* (Aug., '89), about 100. *Meters*, none. *Hydrants*, Coffin, 126 public, 4 private. *Valves*, Peet.

Consumption, not determined. *Pressure*, 80 lbs.

Financial.—Cost, completed works, between $130,000 and $140,000. Bonded debt, Jan. 1, '89), $120,000. Int., 4 %. Further data not determined.

Management.—Three Comrs. Chn., Frank M. Ames. Secy., Jno. Everett. Supt., —— Lyons.

CHELSEA, *Suffolk Co.* (Pop., 21,782; est., 31,000.) Suburb of Boston. Has large manufactories. Has electric lights.

History.—Supplied in '67 from Mystic Water-Works, then owned by Charlestown, but now owned by Boston. Distribution system is owned by Chelsea. All data included under Boston.

CHESHIRE, *Berkshire Co.* (Pop., 1,537; est., 1,500.) At head of one of main branches of Hoosac river, in valley between high mountains. Settled in '67; not incorp. No sewers or electric lights.

History.—Built in '75 by Cheshire Water Co. Engr., Jno. J. Marsh, North Adams.

Water Supply.—Brooks fed by mountain springs, by gravity from impounding Reservoir.

Dam and Reservoir.—Cap., about 900,000 galls.; 66 x 200 ft. x 10 ft. deep; 200 to 280 ft. above village. Dam of stone masonry, 40 ft. long, 12 ft. high; built across rocky gorge. Contr., Hascal Dodge, Pittsfield.

Filter.—Water is drawn from pond, or reservoir, through a 6 x 12-ft. chamber in dam containing gravel and charcoal placed between wire screens.

Distribution.—*Mains*, 8 to 3-in. c. i., 4 miles; from R. D. Wood & Co., Philadelphia, Pa., laid 4 ft. deep and covered with 1 ft. of charcoal braize to prevent freezing. *Services*, galv. i. *Taps*, 125. *Meters*, none. *Hydrants*, kind not given, 17.

Consumption, unknown. *Pressure*, 125 lbs.

Financial.—Cost, $17,000. Cap. stock, $15,000. Debt, none. Ann. op. exp., $100. Ann. rev.: consumers, $900. Hydrant rental, free.

Management.—Prest., Jackson B. Farnum. Secy., Geo. Dean. Treas., Jas. G. Northup. Supt., H. A. Northup.

CHICOPEE, *Hampden Co.* (Pop., est., 6,800.) On Chicopee river at its junction with Connecticut river, three miles from Springfield. Settled in 1636; incorp. in '18. Has sewers and electric lights.

History.—In '45, water supply was obtained from springs. In '77, Chicopee Water Co. built works. Engr., Stockwell Bettes, Springfield. In '86, high-service system was added; Engr., A. H. Howland, Boston, Mass.; ownership not given.

Water Supply.—Brook and 6 large wells, by gravity and pumping to tank. Brook is fed by springs and impounded by dam.

Impounding Dam and Reservoir.—Cap., 5,250,000 galls.; covers 3½ acres and has average depth of 6 ft. Surface of water is from 20 to 80 ft. above town. *Dam:* 150 ft. long, 12 ft. high, and 8 ft. wide on top, with earth slopes 2½ to 1 on inner, and 1½ to 1 on outer side. In center is brick and cem. wall resting on bed of quicksand confined by two rows of 6-in. sheet-piling driven 12 ft. below base of dam. Contr., W. C. McClellan, Boston. Cost, about $5,000.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; two Deane pumps. *Boiler:* upright, from R. F. Hawkins, Springfield.

Tank.—Cap., 280,000 galls.; 40 x 30 ft.; from R. F. Hawkins, Springfield.

Distribution.—*Mains*, c. i., w. i. and cem., 12 miles. *Services*, lead and w. i. Pipe from National Tube Works Co., McKeesport, Pa. *Taps*, 830. *Meters* 3. *Hydrants*, Chapman, 37. *Valves*, Chapman.

Consumption, 30,000 galls. *Pressure:* ordinary, 60 lbs.; fire, 100 lbs.

Financial.—Cost, $81,500. Cap. stock, $75,000. Debt, $18,000. Int., 4½%. Ann. op. exp., $2,000. Ann. rev.: consumers, $7,300; city, $1,500. Hydrant rental, $40.

Management.—Prest., Emerson Gaylord. Treas. and Supt., E. R. Stickney.

CHICOPEE FALLS, *Hampden Co.* (Pop., 4,000; est., 5,000.) On Chicopee river. Settled in 1640, and was part of Springfield until '48. Incorp. a fire district. Has sewers. No electric lights.

History.—Built in '81-3, by village and Chicopee Manufacturing Co., jointly, former owning distribution system, latter pumping machinery and reservoir.

Water Supply.—Chicopee river and springs, pumping to reservoir. Springs are collected in basin 25 x 35 ft. x 2 ft. deep.

Pumping Machinery.—Dy. cap., 480,000 galls.; water-power, make not given; in mills of above Co.

Dam.—For water-power; timber, founded on ledge, 307.86 ft. long on crest and about 10 ft. high. Backs up water for about two miles. Built in '59.

Distribution.—*Mains*, 8 to 3-in. c. i., 4½ miles. *Services*, w. i. *Taps*, 325. *Meters*, 2. *Hydrants*, Holyoke, Chapman, 50.
Consumption, unknown. *Pressure*, 55 to 100 lbs.

Financial.—Cost: to village, $21,500; to Co., not given. Debt, village, $12,600: $2,600 at 5, $2,000 at 4½ and $8,000 at 4%. Ann. op. exp., village, about $500; Co., not given. Ann. rev: consumers, $2,321. Co. has one-half revenue from consumers, and is paid $365 for hydrant rental.

Management.—Prudential Com. Secy. and Treas., H. J. Boyd.

CLINTON, *Worcester Co.* (Pop., 8,029; est., 10,000.) On Nashua river. Engaged in manufacturing. Incorp. village in '50. Sewers built in '89. Has electric lights.

History.—Built in '82 by town. Des. Engr., M. M. Tidd, Boston. Const. Engr., Jno. T. Langford. Contrs., R. D. Wood & Co., Philadelphia, Pa. Supplies and operates works of Lancaster Water Co.

Water Supply.—Springs and surface water, by gravity from storage and impounding reservoirs. Drainage area, about 700 acres.

Dams.—Four. Two dams forming storage reservoirs are of earth, with paved slopes. Dam forming new storage reservoir, built in '88-9, known as Fitch pond, of earth, with stone heart-wall and spillway. A 16 and a 6-in. pipe extend through the dam. Engr., not given Contr., Thos. Hennessy, Holden. Cost, $4,610 for construction, and $5,075 for land and water rights. Impounding reservoir dam, not described.

Storage and Impounding Reservoirs.—Combined cap., 60,000,000 galls. Three storage and one impounding. First two formed by earth dams with paved slopes: third, has cap. of 40,000,000 galls., and was recently built, in '88-9, at head of supply, in town of Sterling; covers 13¼ acres to depth of 14 ft. These reservoirs have drainage area of about 200 acres, and from them water passes through valley having about 500 acres additional drainage to impounding reservoir, not described.
Conduit to Distributing Reservoir: 16-in. c. i., 6 miles long.

Burditt Hill Distributing Reservoir.—Cap., 2,500,000 galls; in city, 168 ft. sq. by 15 ft. deep; earth, with masonry heart-walls and concrete bottom.

Distribution.—*Mains*, 6 to 14-in. c. i., 26 miles; 16 miles laid by Inman Bros., N. Y. City. *Services*, w. i. and cem. *Taps*, 1,031. *Meters*, Crown, Union, Draper, 43. *Hydrants*, Chapman, 190: 135 public and 55 private. *Valves*, Chapman.
Consumption, 400,000 galls. *Pressure:* Ordinary, 80. Fire, 100 lbs.

Financial.—Cost, $270,000. Debt, $270,000. Int., 4%. Sinking fund, $15,884. Ann. op. exp. $3,500. Ann. rev.: consumers, $15,000; city, $3,000. Hydrant rental, $3,000 for all.

Management.—Two Comrs.: Prest., Jonas E. Howe, and Treas., Jno. W. Corcoran. Supt., H. H. Lowe. Registrar, Jno. F. Philbin.

COCHITUATE, *Middlesex Co.* (Pop., 1,161; est., 1,200). In town of Wayland. Incorp. in '35. No sewers. Has electric lights.

History.—Built in '78 by town. Des. Engr., Hiram W. Blaisdell, Concord.

Water Supply.—Snake Brook, by gravity from impounding reservoir, with direct pumping for fire protection. Drainage area, ⅝ sq. m.

Dam and Reservoir.—Cap., 16,000,000 galls.; area, 13 acres; 68 ft. above village. Dam of earth, 130 ft. long, 30 ft. high. *Heart-wall:* rubble masonry, 3 ft. thick at bottom, 22 ins. at top.

Filter Gallery.—A trench 400 ft. long was dug near bank of reservoir from 10 to 6 ft. below high water, with two 80-ft. branches extending beneath reservoir. Dry stone culvert, 18 ins. high by 12 ins. wide, was built in trench, and covered with earth. Gallery terminates in a 6-ft. well, 200 ft. above dam; 227 ft. of 10-in. cast-iron

pipe leads to chamber below dam connecting with supply main. There has been some trouble with water from filter gallery on account of vegetable growth making an ocherous deposit in pipes.

Pumping Machinery.—Dy. cap., not given; Amoskeag rotary, driven by 30-in. turbine wheel of 40 H. P. An 18-in. pipe leads through dam to pump, and in case of fire, supply is drawn through this directly from pond and pressure is increased for fire purposes.

Distribution.—*Mains* 10 to 4-in. c. i., 6 miles; laid by Inman Bros., New York City. *Services*, w. i. *Taps*, 215. *Meters*, none. *Hydrants*, Mathews, 34. *Valves*, Chapman.

Consumption, unknown, *Pressure:* Ordinary, 30 lbs. Fire, 88 lbs.

Financial.—Cost, $30,000. Debt, $30,000: $25,000 at 5, and $5,000 4%. Sinking fund, $5,168. Ann. op. exp., $250. Ann. rev.: consumers, $2,500; city, $381. Hydrant rental, $12.

Management.—Three Comrs. Prest. A. H. Bryant. Clerk, W. H. Bent. Supt., R. Bent.

COHASSET, *Norfolk Co.* (Pop., 2,182, est., 2,300.) On south shore of Massachusetts bay, 21 miles from Boston. Summer resort. No sewers or electric lights.

History.—Built in '86 by Cohasset Water Co. Engr., M. M. Tidd, Boston. Contrs., Wm. McClellan, Boston, and Calvin Horton & Son, Somerville.

Water Supply.—From 65 2-in. driven wells, pumping to reservoir.

Pumping Machinery.—Dy. cap., 750,000 galls.; Blake comp., dup.

Reservoir.—Cap., 1,500,000 galls.; 150 ft. sq., has 14 ft. of water; slopes paved, bottom cemented.

Distribution.—*Mains*, 12 to 4-in. c. i., 7 miles. *Services*, cem.-lined i. Pipe from Gloucester Iron Works, Philadelphia, Pa.; laid by W. C. McClellan, Boston. *Taps*, 175. *Meters*, none. *Hydrants*, Chapman, 30. *Valves*, Chapman.

Consumption, not given. *Pressure*, 60 lbs.

Financial.—Withheld, except hydrant rental, $50. *Est:* cost, $86,000. Ann. op. exp., $2,000. Ann. rev.: consumers, $4,600; city, *actual*, $1,500.

Management.—Prest. C. A. Welsh, Boston. Treas., Waldo Higginson. Registrar, Caleb Lathrop. Supt., D. N. Tower.

CONCORD, *Middlesex Co.* (Pop. 3,922.; est., 3,900.) On Concord river. Portion of village supplied with water is generally level, but part of village is on undulating ground. Settled in 1635. Not incorp. Has electric lights.

History.—Built in '74 by town. Engr., Wm. Wheeler, Boston. Contrs., Ferris & Halladay, Jersey City, N. J.

Water Supply.—Sandy pond, by gravity. Area of pond, 152 acres; drainage area, 350 acres.

Reservoir.—Cap., 2,500,000 galls.

Distribution.—*Mains*, 12 to 4-in. w. i. and cem., 24½ miles. *Services*, enam. i. Pipe furnished by contractors. *Taps*, 650. *Meters*, 5. *Hydrants*, Whittier, 102. *Valves*, Whittier.

Consumption, 700,000 galls. *Pressure*, 44 lbs.

Financial.—Cost, $142,000. Debt, (in '86) $130,000. Int., 4%. Sinking fund, $29,000. Ann. op. exp., about $1,000. Ann. rev.: consumers, $14,000; city, $1,500. Hydrant rental, $15.

Management.—Three Comrs.: Samuel Hoar, E. C. Damon, A. J. Hosmer. Supt., Jno. O. Haskell.

COTTAGE CITY, *Dukes Co.* (Pop., 672; est., winter, 1,000, and in summer runs above 10,000.) On Martha's Vineyard, island off Atlantic Coast. Summer resort. No sewers. Has electric lights.

History.—Fire protection system built in '84 by fire district under direction of Moses Jay, Jr. **Water Supply.**—Lake Anthony, by direct pumping. Lake has area of 10 acres, and is supplied by springs. **Pumping Machinery.**—Dy. cap., 500,000 galls.; Knowles. **Distribution.**—*Mains*, c. i. ½ mile. *Hydrants*, Holyoke, 12. *Pressure*, 180 lbs. **Financial.**—Cost, $10,000. Debt, $300. Ann. op. exp., $325. **Management.**—Selectman, H. J. Green. Town Treas., Z. D. Linton.

NOTE.—Legislature has granted town right to construct new works, and plans have been made. Early in '90 town voted to accept proposition to build works made by Wheeler & Parks, Boston. Supply, Beach Grove springs, by gravity.

DALTON, *Berkshire Co.* (Pop., 2,052; est., 2,300.) No public sewers or electric lights.

History.—Built in '84 by fire district of town. No engrs. or contrs.

Water Supply.—Mountain brook, by gravity from reservoir.

Reservoir.—Cap., 3,250,000 galls.

Distribution.—*Mains*, c. i., 11¼ miles. *Services*, galv. i. *Taps*, 440. *Meters*, none. *Hydrants*, Ludlow, 49.

Consumption, 37,000 galls. *Pressure*, 141 lbs.

Financial.—Cost, $51,102; to Dec. 31, '87, $49,000. Debt, $50,000. Int., 4%. Ann. op. exp., $400. Ann. rev.: consumers, $3,100.

Management.—Three Comrs. Treas., Jno. D. Carson. Clerk, W. B. Clark. Supt., A. E. Chamberlain.

DANVERS, *Essex Co.* (Pop., 6,598; est., 8,000.) On Porter's river, arm of sea, on rolling ground rising from sea to height of 250 ft. Engaged in manufacturing shoes, leather and brick; also in gardening and farming. Not incorp. No sewers. Has electric lights.

History.—Built in '76 by town. Des. Engr., Geo. H. Bishop. Const. Engr. and Contr., Geo. H. Norman, Newport, R. I. This system supplies villages of Tapleyville, Danvers Centre and Danversport, in town of Danvers, and Middleton, which is on pipe line.

Water Supply.—Middleton and Swan ponds, pumping to reservoir. Middleton pond is 5 miles from town, has area of 90 acres, drainage area of 3 sq. m., and is about 30 ft. above sea-level. Swan pond has area of 69 acres, and drainage area of about 200 acres.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; Worthington.

Force Main.—Is 12 ins. in diam. and 13,879 ft. long.

Reservoir.—Cap., 5,500,000 galls.; on Hawthorne hill, 230 ft. above sea-level, in excavation and embankment, oval. Contrs., Cressey & Noyes. Built by State.

Distribution.—*Mains*, 16 to 6-ins. w. i., and cem., 37¼ miles. *Services*, w. i. *Taps*, 1,282. *Meters*, 30. *Hydrants*, Ludlow, 207. Mains, Dec. 31, '77, 25 miles; Taps, 515; Hydrants, 168. Mains, Dec. 31, '79, 28 miles; Taps, 606; Hydrants, 183.

Consumption, 450,000 galls. *Pressure*, 50 to 85 lbs.

Financial.—Cost, $256,257. Debt, $212,000: $180,000 at 5 and $32,000 at 4%. Sinking fund, $30,676. Ann. op. exp., $6,011. Ann. rev.: consumers, $18,499; city, $1,000. Hydrant rental, $20. Cost to Dec. 31, '77, $177,516; to '79, $186,348. Rev. for '77, $4,738; for '79, $14,461.

Management.—Three Comrs. Registrar, Henry Newhall. Supt. of Pipes, D. J. Harrigan.

NOTE.—A few more details are given in the Tenth Census U. S., Vol. XVII, Water Supply of Cities, p. 199.

DANVERS CENTRE, *Essex Co.* See Danvers.

DANVERSPORT, *Essex Co.* See Danvers.

DEDHAM, *Norfolk Co.* (Pop., 6,233; est., 6,700.) On Charles river. Engaged in manufacturing woolen goods, loom-pickers, brooms, absorbent cotton, suspenders, cocoa, chocolate, and gold-leaf. Settled 1635; incorp. village in 1636. No sewers. Has electric lights.

History.—Built in '81 by Dedham Water Co. Engr., Percy M. Blake, Hyde Park. Contrs., Goodhue & Birnie, Springfield.

Water Supply.—Well, pumping to stand-pipe. *Well:* 26 ft. in diam., 18 ft. deep, lined with heavy dry stone-work, faced on inside from 3 ft. above bottom to 1 ft. below top with 12 ins. of brick and cem.; roofed and ventilated.

Pump-Well.—Brick, 8 ft. in diam. and 18 ft. deep, connected with supply well by 16-in. c. i. pipe.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; Knowles; 2,000,000 dup., 1,000,000 comp. *Boilers:* two 60 H. P. return tubular.

Stand-Pipes.—*Old:* cap., 242,000 galls.; 20x103 ft.; plate-iron; [from Kendall & Roberts, Cambridgeport. *New:* cap., 540,000 galls.; 42x51 ft.; for storage; on elevation 52 ft. above foundation of old stand-pipe.

Distribution.—*Mains*, 10 to 4 in. w. i. and cem., 20 miles. *Services*, enam. i. *Taps*, 726. *Meters*, 8. *Hydrants*, Ludlow, 122 public, 9 private. *Valves*, Ludlow, Chapman.

Consumption, 180,063 galls. *Pressure*, 50 to 72 lbs.

Financial.—Cost, $165,000. Cap. stock, $100,000; paid 5% dividend for year '87-8. Bonded debt, $65,000. Int., 5%. Ann. op. exp., $8,713, including $1,470 taxes. Ann. int., $2,550. Ann. rev.: consumers, about $11,292; city, $5,165. Hydrant rental, $45 for first 100, $35 for additional; public buildings free.

Management.—Prest., Winslow Warren. Treas., Jno. R. Bullard. Secy. and Supt., Wm. F. Hill.

EAST BRIDGEWATER, *Plymouth Co.* See Bridgewater.

EASTHAMPTON, *Hampshire Co.* (Pop., 4,206; est., 4,300.) Engaged in manufacturing cotton, silk, elastic and rubber goods, buttons and steam pumps. Incorp. in '88. Has sewers and electric lights.

History.—Built in '73 by town.

Water Supply.—Williston pond and springs, by direct pumping from former and gravity from latter. Pond has area of two acres, av. depth of 8, and max. depth of 15 ft. Springs are on Mt. Tom, and furnish about one-half of supply; drawn upon in '88.

Reservoir.—Cap., 600,000 galls; receives supply from springs; on sides of Mt. Tom. Has 3 sides and bottom of rock, and dam in front; 185 ft. above center of town. Built in '88.

Pumping Machinery.—Dy. cap., 1,000,000 galls. In '88, pump in use had cap. of 360,000 galls., and was owned and operated by Rubber Thread Co., who received $600 per year for same.

Distribution.—*Mains*, c. i., 4 miles. *Services*, i. *Taps*, 140. *Meters*, none. *Hydrants*, kind not given, 75.

Consumption, 60,000 galls. *Pressure:* Ordinary, 75 lbs. Fire, 110 lbs.

Financial.—Cost, $25,000. Debt, $15,000. Int., 4½%. Ann. op. exp., $1,200. Ann. rev.: consumers, $1,650.

Management.—Five Comrs. Prest., G. H. Newman. Supt. Geo. L. Manchester.

EVERETT, *Middlesex Co.* (Pop., 4,159; est., 7,000.) Three miles from Boston. Engaged in manufacturing, especially chemicals and wheels.

History.—Supplied in '71 from Mystic Water-Works, Charlestown, now part of Boston system, which see.

FALL RIVER, *Bristol Co.* (Pop. 48,961; est., 68,000.) On east side of Mt. Hope bay, arm of Narraganset bay. On irregular ground, rising at some points 260 ft. above tide-level. One of largest cotton manufacturing cities in New England. Has granite quarries near by, and is largely engaged in commerce. Settled in 1659; incorp. city in '54. Has sewers and electric lights.

History.—Built in '71-4 by city, pop. in '70 having been 26,766. Des. Engr., W. McAlpine. Const. Engrs., Geo. A. Briggs, with Wm. Rotch as Asst. Consult. Engr., Jas. P. Kirkwood. Contrs., Jno. Mangan, Salem, and Geo. W. Lobdell, Mattapoisett.

Water Supply.—Watuppa lake, pumping to stand-pipe and tank. Lake is 128 ft. above tide-water, has area of 3,478, and drainage area of 16,522 acres, storage cap. of 10,000,000,000 galls., mean dy. discharge of 35,000,000 galls., and furnishes water-power for manufactories in Fall River.

Buildings.—Engine-house is on coffer-dam 60 ft. from west shore of lake and 9,472 ft. from main street of city; rough ashlar granite, after designs by J. M. Wilson, Architect. Engine-room 56 x 80 ft., x 34 ft. high. The boiler-room is 23 x 53½ ft., with a chimney 112 ft. high. This chimney was struck by lightning in '85 and so badly damaged it that it was found necessary to tear it down and erect new one at cost of $6,000; interesting description of accident and means employed to take down old chimney is given in *Eng. News*, vol. XVI., p. 118. There is a coal-house 21 x 86 ft., and granite building divided into tenements for engineer and his assistant, with storage basement below. Gate-house is 8 x 10 ft., with its floor 10 ft. below lake surface. Arched conduit 6 ft. wide and 4 ft. high conducts water to engine-house, and there divides into four branches leading to as many pump wells.

Pumping Machinery.—Dy. cap., 13,000,000 galls.; Whittier, Worthington and 6,000,000 Davidson. Most of pumping in '87 was done by Worthington and Davidson pumps. *Boilers:* Whittier, Providence Steam Engine Co.

Stand-Pipes.—Two, equalizers of pressure, enclosed in masonry tower 116 ft. high. Each pipe is of boiler-iron, 42 ins. in diam.; one is 60, other 80 ft. high.

Tank.—Cap., about 1,000,000 galls. Made by Cunningham Iron Works, Boston; 73 x 37 ft.; 305 ft. above tide-water.

Distribution.—*Mains*, 24 to 6-in. c. i., 61.3 miles. *Services*, lead. Pipe and specials from Warren Foundry & Machine Co., Phillipsburgh, N. J., R. D. Wood & Co., Philadelphia, Pa., and Gloucester Iron Works, Philadelphia, Pa. *Services*, ¾ to 2-in. lead. *Taps, or services*, 4,412. *Meters*, 3,138: 2,115 Crown, 480 Union Rotary, 270

Gems; remainder, Despar. Balls & Fittz, Worthington : 71 % of service pipes are metered. *Hydrants*, Whittier, Newport, Coffin, 625. *Valves*, Whittier, Chapman.

Consumption, 1,768,524 galls. *Pressure*, 80 lbs.

Financial.—Cost, including op. exp. since construction, $1,814,004. Bonded debt, $1,700,000. Int., av., 5.7%. Sinking fund, $180,127. Ann. op. exp., $26,000. Ann. int., $96,970. Ann. rev.: consumers, $85,107; city, $30,000. First cost, $1,431,365.

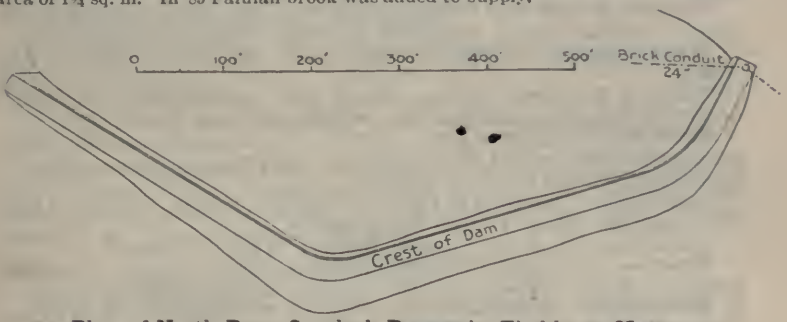
Management.—Watuppa Water Board of 5. Prest. Weaver Osborne. Clerk and Registrar, Wm. W. Robertson. Supt., Patrick Kieran. Inspector of Meters, Saml. Ogden. Pumping Engr., Jno. Lufkin.

NOTE.—More extended description of these works is given in *Eng. News*, vol. V., pp. 180, 188, 211, 219, 229 and 243; also Vol. VIII., p. 264. For minor details see Tenth Census U. S., vol. XVII., Water Supply of Cities, p. 213.

FITCHBURG, *Worcester Co.* (Pop., 12,429; est., 18,000.) On Nashua river, in long narrow valley from which hills rise on each side 250 ft. Engaged extensively in manufacturing, especially cotton and woolen goods, chairs, engines and machinery. Incorp. town in 1764, city in 72. Has sewers and electric lights.

History.—Built in 71-2 by city. Des. Engr., Phineas Ball, Worcester. Const. Engrs., Geo. Raymond and W. A. Smith.

Water Supply.—Scott and Falulah brooks, by gravity, from storage reservoirs, one on each. First supply was from natural flow of Scott brook, a stream having drainage area of about 1 sq. m.; later Shattuck brook was connected with Scott brook by 14-in. w. i. and cem. pipe. This brook is 8,300 ft. distant, and has drainage area of 1¼ sq. m. In '83 Falulah brook was added to supply.



Plan of North Dam, Overlook Reservoir, Fitchburg, Mass.

Dams and Reservoirs.—Combined cap., 292,100,000 galls.

Scott Impounding Dam and Reservoir: Cap., 210,000,000 galls.; area, 35 acres; dam of gravel, with heart-wall of rubble masonry in cement; about 700 long, 46 ft. high, 35 ft. wide on top, 245 at bottom, in highest part; inner slope, 3 to 1, paved; outer slope, 2½ to 1, unpaved. *Heart-wall*, 14 ins. thick and 36 ft. ft. high. Dam founded on sand. Depth of water at dam, 40 ft. *Spillway*, at east end of dam, connecting with ravine, 35 ft. long, lined with masonry, free. *Discharge-pipe*, 21 in., c. i. Does not leak. Built in '79. Const. Engr., Thos. C. Lovell, Fitchburg. Cost $50,000.

A 2-ft. brick conduit, 7,916 ft. long, leads from the Scott to the Overlook reservoir.

Overlook Dams and High-service Distributing Reservoir: Cap., 60,000,000 galls.; area, 13.65 acres; elevation, 400 ft. above city. Formed by building two dams across ravine; puddled gravel, with earth heart-wall. *South dam* is 400 ft. long, 42 ft. high 23 ft. wide on top, with inner slope, 2 to 1, paved, outer, 1½ to 1, unpaved. *Heart-wall*, stone in hydraulic cement, 2 ft. thick and 40 ft. high. *Discharge pipes*, two 12, and one 16-in., one of 12-in. being waste-pipe. Depth of water at dam, 40 ft.

North dam is 1,000 ft. long, irregularly curved (see accompanying plan) 22 ft. high, with inner slope, 2 to 1, outer, 1½ to 1. *Heart-wall*, stone in cement, 2 ft. thick. *Spillways*, none. Leaks but little. Built in 72. Des. Engr., Phineas Ball Worcester; Const. Engr., W. A Smith. Contr., Geo. H. Norman, Newport, R. I Cost, $38,239.

Marshall Dam and Low-service Reservoir: Cap., 1,100,000 gals; dam is 21 ft. high 1,150 ft. down the ravine from Overlook reservoir; elevation, 200 ft. above city.

Falulah Dam and Reservoir: Cap., 20,000,000 galls.; area, 3 acres. Depth at dam, 20 ft.; av. depth, 10 ft. At junction of Scott and Shattuck brooks. Dam of stone-

with puddled gravel filling on wet side sloping 2½ to 1; 400 ft. long, 23 ft. high, 20 ft. thick at top and bottom, founded on hard-pan. Is 235 ft. above city, and supplies Marshall reservoir. *Spillway* is 150 ft. from east end, lined with hard pine; 80 ft. long, sill 3 ft. below top of dam; slope, 1 to 1. *Discharge-pipe*, 24 in. Built in '83. Engr., Thos. C. Lovell, Fitchburg.

Marshall Dam and Low-service Reservoirs: Cap., 1,000,000 galls; elevation 200 feet above city. Dam is 21 ft. high. On Scott brook.

Distribution.—*Mains*, 16 to 2-in. c. i., w. i. and cem., 38.14 miles; in '88 cost of repairs per mile were, w. i. and cem., $81.20; c. i., $2.05. *Services*, ¾ to 6-in. w. i., w. i. and cem. *Taps*, 2,456. *Meters*, 657. *Hydrants*, Whittier, Chapman, 268. *Valves*, kind, do.

Consumption, 1,300,000 galls. *Pressures:* Low-service, 80 lbs. High-service, 160 lbs.

Financial.—Cost, $613,324. Debt, $500,000. Int., av. 5.5%. Sinking fund, $166,467. Ann. op. exp., $12,768. Ann. int., $27,930. Ann. rev.: consumers, $34,272; city, $16,000. Hydrant rental, $50; first allowed in '85. First cost, $173,000. Op. exp. for '80, $5,713; rev. $15,641.

Management.—Three Comrs. Prest., Chas. H. Brown. Registrar, A. W. F. Brown. Supt. and Clerk, Thomas C. Lovell.

FLORENCE, *Hampshire Co.* See Northampton.

FRANKLIN, *Norfolk Co.* (Pop., 4,051; est., 4,500.) Engaged in manufacturing straw, woolen and rubber goods. Incorp. town in 1778. No sewers. Has electric lights.

History.—Built in '84 by Franklin Water Co., under 25-years franchise. Des. Engr., G. Norman Weaver. Contr., Geo. H. Norman; both of Newport, R. I.

Water Supply.—Two wells, pumping to tank. One well is 20x30 ft.; other 18x33 ft.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Knowles comp., dup., cond., with 18 and 10-in. steam, and 14-in. water cylinders, and 10-in. stroke.

Stand-Pipe.—Cap., 423,000 galls.; 30x80 ft.; from E. Hodge & Co., East Boston, Mass.; of ⅝-in. iron; on rock foundation on site of tank which gave way Oct., '87; latter was 40x35 ft. and ⅜ in. thick at bottom.

Distribution.—*Mains*, 12 to 4-in., w. i. and cem., 8 miles. *Services*, w. i. and lead. *Taps*, 260. *Meters*, 6. *Hydrants*, Pattee, 67.

Consumption, not given. *Pressure:* Ordinary, 70 lbs. Fire, 140 lbs.

Financial.—Cost, $134,013. No debt. Ann. op. exp., $2,162. Ann. rev.: consumers, $3,500; city, $3,655. Hydrant rental, $48 for first 50 and $35 for additional.

Management.—Prest., Jos. G. Ray. Secy., G. W. Wiggin. Treas., G. Norman Weaver, Newport, R. I. Supt., Wm. E. Nason.

GARDNER, *Worcester Co.* (Pop., 4,998; est., 9,000.) Built on high ground in rough country. Incorp. town in 1785. Has large chair shops. No sewers. Has electric lights.

History.—Built in '82 by Gardner Water Co. Des. Engr., S. L. Wiley, Omaha, Neb.

Water Supply—Crystal Lake, by pumping to reservoir. Lake has area of 156 acres, drainage area of about 1 sq. m.

Pumping Machinery.—Dy. cap., 4,000,000 galls.; Deane, 2,500,000 comp. cond., and 1,500,000.

Reservoir.—Cap., 5,000,000 galls.; 150x400 ft., x20 ft. deep, with puddled bottom and paved slopes; about 180 ft. above pumps and from 100 to 250 ft. above town.

Distribution.—*Mains*, 14 to 4-in. c. i., 21 miles. *Services*, w. i. *Taps*, 695. *Meters*, 27. *Hydrants*, Ludlow, Pattee, 79. Valves, Ludlow.

Consumption, 300,000 galls. *Pressure*, 80 lbs.

Financial.—Cost withheld; est., $200,000. Stock and bonds (in '88), $160,000. Int. not given. Ann. op. exp. withheld, est., $4,000. Ann. rev.: consumers, withheld, est., $15,000; city, $4,750. Hydrant rental, $60.

Management.—Prest., C. H. Green. Secy., V. W. Home. Treas. and Supt., H. W. Conant.

GLOUCESTER, *Essex Co.* (Pop., 19,329; est., 22,000.) On Cape Ann. Largest fishing port in United States. Also engaged in foreign and domestic commerce and production of granite. Incorp. No sewers. Has electric lights.

History.—Built in '85 by Gloucester Water Supply Co. Engr., G. Norman Weaver, Newport, R. I.

Water Supply.—Dyke's pond, pumping to reservoir. Pond has area of 408 acres.

Pumping Machinery.—Dy. cap., 5,000,000 galls.; Knowles.

Reservoir.—Cap., 10,000,000 galls.

Distribution.—*Mains*, 18 to 6-in. w. i. and cem., 28 miles. *Services*, 925. *Meters*, Worthington, 30. *Hydrants*, Chapman, 150. *Valves*, Chapman.

Consumption, 300,000 galls *Pressure*, 70 lbs.

Financial.—Cost, withheld, est., $445,000. Cap. stock, $250,000. Bonded debt, $250,000 Int., 5%. Ann. rev.: consumers, withheld. est., $34,000; city, $7,500. Hydrant rental, $46.66.

Management.—Prest., J O. Proctor. Secy., D. W. Low. Treas., G. Norman Weaver, Newport, R. I. Supt., Jno. E. McCusker.

CRAFTON and NORTH CRAFTON, *Worcester Co.* (Pop., 4,030; est., 6,000) Manufactures boots and shoes, cotton and woolen goods. Incorp. Has no sewers or electric lights.

History.—Built in '86 by National Water-Works Syndicate, Boston. Engr., Geo. Alexander, Boston. Contrs., Ferris & Halladay, Jersey City, N. J.

Water Supply.—Surface and artesian wells, pumping to stand-pipe. Surface well is 12 x 95 ft., x 20 ft. deep, with 17 ft. of water when full; 100-ft. artesian well.

Pumping Machinery.—Dy. cap., 1,750,000 galls.; one 750,000, make not given, and one 1,000,000 Worthington comp., added in '89. *Boilers:* 65 H. P. steel, was added in '89.

Stand-Pipe.—Cap., about 110,000 galls.; 25 x 30 ft.

Distribution.—*Mains*, 10 to 4-in. c. i., 10 miles. *Services*, enam. i. *Taps*, 241. *Meters*, none. *Hydrants*, kind not given, 93. *Valves*, Ludlow.

Consumption, 125,000 galls. *Pressure*, 100 lbs.

Financial.—Cost, $120,000. Cap. stock, $65,000. Bonded debt, $65,000. Int., 5%. Ann. op. exp., $2,500. Ann. rev.: consumers, withheld. est., $7,400; city, $2,500. Hydrant rental, about $28.

Management—Prest., F. J. Parmlee. Secy., J. F. Ferris. Supt. and Treas., Solon F. Smith.

GREAT BARRINGTON, *Berkshire Co.* (Pop., 2,715; est., 4,800.) On Housatonic river, in long winding valley enclosed by rocky hills. Engaged in manufacturing, and quarrying variegated marble and blue stone. Settled in 1730. Incorp. village in 1761. Has sewers and electric lights.

GREAT BARRINGTON WATER CO.

History.—Built in '67.

Water Supply.—Mountain stream, by gravity from reservoir, and by pumping.

Dam and Reservoir.—Are 100 ft. above town; dam 8 ft. high and 100 ft. long.

Pumping Machinery.—Dy. cap., 500,000 galls.; Deane.

Filter.—At outlet of reservoir, stone, gravel and charcoal.

Distribution.—*Mains*, c. i, w. i. and cem., 4½ miles. *Services* not given. *Taps* (in '87), 315. *Meters*, none. *Hydrants*, 22.

Consumption and Pressure, not given

Financial.—Cost (in '88), $28,000. No debt. Ann. op. exp., withheld, est., $1,000. Ann. rev.: consumers, withheld, est., $5,000; city, withheld.

Management.—(In '88.) Prest., Jno. S. Dodge. Secy., B. Palmer. Treas., F. T. Whiting. Supt., R. N. Couch.

NOTE.—Inquiries for '89 were ignored.

BERKSHIRE HEIGHTS WATER CO.

History.—Built in '86-9. Engr., E. D. Brainard, present Prest. Contrs., none.

Water Supply.—Green river, pumping to reservoir.

Pumping Machinery.—Dy. cap., not given; Deane water-power.

Reservoir.—Cap., 1,000,000 galls.

Distribution.—*Mains*, 6-in. c. i. Other data not determined, or withheld.

Pressure, 130 lbs.

Financial.—Cost, $25,000. Cap. stock, $20,000. Debt, $25,000. Int., withheld. Other data not determined.

Management.—Prest., Treas. and Supt., E. D. Brainard. Secy., Wm. E. Cooper.

GREENFIELD, *Franklin Co.* (Pop., 3,903; est., 5,000.) On rolling land, one mile from, and 100 ft. above, Connecticut river. Engaged in manufacturing, trade and agriculture. Settled in 1738; incorp. in 1753. Has sewers and electric lights.

History.—Built in '70 by fire district. Des. Engr., Alfred R. Field. Const. Engr. and Contr., S. L. Wiley.

Water Supply.—Brook, by gravity from impounding reservoir.

Dam and Reservoir.—Cap., 17,800,000 galls.; area of 5¼ acres; drainage area, 8 sq. m. of mountainous country; 5 miles from, 230 ft. above, village. Dam of stone, with ends built into rock; 60 ft. long, 35 ft. high, 16 ft. thick at bottom and 10 at top; cost, $8,500.

Supply Main.—Is 5 miles long, size not given; originally 8 and 6 ins. in diam. iron, coated.

Distribution.—*Mains*, 14 to 4-in. c. i., 22 miles. *Services*, galv. i. *Taps*, 1,000. *Meters*, 6. *Hydrants*, Mathews, Ludlow, Chapman, 70. *Valves*, kind, do.

Consumption, 450,000 galls. *Pressure*, 95 lbs

Financial.—Cost, about $155,000. Debt, $88,000, of which $60,000 is in bonds, and $28,000 in loans from savings banks. Sinking fund, none. Int., 4%. Ann. op. exp., $1,700. Ann. rev.: consumers, $11,750. First cost, $80,000; of extensions in '85, $60,000.

Management.—Comrs.: A. Withey, E. A. Newcomb, C. T. Wiley, Jas. Porter. Report by A. A. Rankin, ex-Comr.

HAVERHILL, *Essex Co.* (Pop., 18,472; est., 27,000.) On Merrimac river at head of tide water, on hilly ground rising in places 350 ft. above tide level. Incorp. town in 1645, city in '70. Engaged in various manufactures, ranking as second city in United States in production of boots and shoes. Has electric lights.

History.—Built in '01 by Haverhill Aqueduct Co.

Water Supply.—From springs and ponds, by gravity and pumping to stand-pipe. Originally from ponds near city, water being distributed through wooden logs. Round pond, 35 acres area, and 147 ft. above river, supplied village for several years; then water was taken from Plug pond, or Lake Saltonstall, of 41 acres area, and 118 ft. above river; in '70 water was pumped into Round pond from Kenoza lake, latter having area of 232 acres at 100 ft. elevation. In '78 water was first pumped from Kenoza lake to stand-pipe to supply higher parts of the city. In '83 an additional supply was taken from Crystal lake, area 175 acres. Lower levels are supplied by gravity from Lake Saltonstall and intermediate levels from Round Pond. Western part of city was originally supplied by small stone reservoir at 170 ft. elevation, but its supply is now from stand-pipe on Mt. Washington.

Pumping Machinery.—Dy. cap., 4,000,000 galls.; two 2,000,000 Worthington comp., dup., built in '79.

Force Main.—Is 16 ins. in diam., 3,000 ft. long; 156 ft. head on pumps.

Stand-Pipe.—Cap., about 210,000 galls.; 30 x 40 ft.; with pipe in center 2 x 50 ft.; 256 ft. above river. From Cunningham Iron Works, Boston.

Distribution.—(In '87.) *Mains*, c. i., w. i. and cem., 40 miles. *Services*, lead. *Taps*, 2,800. *Meters*, Worthington, number not given. *Hydrants*, mostly Chapman, 139. *Valves*, mostly Chapman.

Consumption, about 1,250,000 galls. *Pressure*, 40 to 90 lbs.

Financial.—Cost, withheld, est., $700,000. Cap. stock and bonds (in '88), $400,000. Int., 4½ and 5%. Ann. op. exp., withheld, est. $6,000. Ann. rev.: consumers, withheld, est. $46,000. Hydrant rental, free.

Management.—Supt., C. W. Morse. City Clerk, D. B. Tenney.

NOTE.—Co. ignored all inquiries sent in '89.

HINGHAM and HULL, *Plymouth Co.* (Pop.: Hingham, 4,485; est., 5,000. Hull, 383; est., 500.) Both villages on Massachusetts bay, on irregular ground. Hingham was settled in 1630, is incorp. town, and is a summer resort 17 miles from Boston. No sewers or electric lights.

History.—Built in '79-80 by Hingham Water Co., and extended to Hull in '82. Engrs., M. M. Tidd, Boston, and C. W. S. Seymour, Hingham. Contrs., Goodhue & Birnie, Springfield.

Water Supply.—Accord and Fulling Mill ponds, by gravity, and by pumping to stand-pipe from receiving basin. Accord pond has cap. of 200,000,000 galls., area of 98 acres, drainage area of 365 acres, and is 135 ft. above tide-level. Fulling Mill pond has area of 11 acres, and is 30 ft. above tide-level. Supply was by gravity until '84, when pumping station was built. Supply from Fulling Mill pond was added in '86.

Accord Pond Dam.—Gravel, with concrete heart-wall; about 150 ft. long, 9 ft. high, 15 ft. wide on top; slopes, 3 to 1, inner of coarse gravel and stone and outer being sodded. Top of inner slope is protected by stone wall extending below waterline. This is an old dam, formerly connected with mill, strengthened by digging

trench in center to hardpan and filling with concrete. *Heart-wall:* concrete, 2 ft. wide on top, 8 to 12 ft. high, plastered on face with pure cement concrete, 1 part cement, 2 sand, 4 broken stone. *Spillways:* Two, lined with masonry, free, with slope of 2 to 1; one 10 ft. wide, 50 ft. from one end, and other 7 ft. wide, near other end *Discharge-pipe:* 16 ins. in diam., level. Dam does not leak. Date built, not known. Cost, about $3,000.

Conduit.—Length, 5¼ miles; 16-in. c. i. through dam, then w. i. and cem., 14-in. for 2½, and 12-in. for 3 miles. Copper screen, ¼-in. mesh, over intake end of conduit.

Receiving Basin.—Cap., 350,000 galls.; brick and stone, 120 x 50 ft., x 10 ft. deep. Wall of basin is of dry rubble stone, lined for first 4 ft. with stone paving set in cement, sloping 1½ to 1, and remaining 6 ft. with nearly perpendicular brick wall, surmounted by granite coping.

Pumping Machinery.—Dy. cap., 1,000,000 galls. Direct-acting, dup., cond. *Boilers:* horizontal tubular, from Wm. Allen & Sons, Worcester.

Stand-Pipe.—Cap., 295,000 galls.; 40 x 42 ft.; on base, 90 ft. above tide-level. From E. Hodge & Co., E. Boston.

Distribution.—*Mains*, 14 to 4-in. w. i. and cem., 40 miles. *Services*, w. i. and cem., galv. i. *Taps*, 1,000. *Meters*, none. *Hydrants*, Chapman, 150. *Valves*, Chapman.

Consumption, est., 500,000 galls. *Pressure*, 50 lbs.

Financial.—Cost, $225,000. Cap. stock, $120,000. Bonded debt, $100,000. Int., 5%. Ann. op. exp., $4,000. Ann. rev.: consumers, $18,000; city, $2,250. Hydrant rental, $15, or 10% a year on cost of works. First cost, $80,000.

Management.—Prest., Ebed L. Ripley. Secy. and Treas., Starkes Whiton. Supt., C. W. S. Seymour.

HINSDALE, *Berkshire Co.* (Pop., town, 1,595; est., 1,869.) Incorp. town. No sewers or electric lights.

History.—Built May 20 to Dec. 1, '89, by fire district. Engrs., D. H. & A. B. Tower, Holyoke.

Water Supply.—Springs and brooks, by gravity from reservoir.

Dam and Reservoir.—Cap., 40,000,000 galls.; area, 9 acres. Contrs., Dewyer Bros., Dalton.

Distribution.—*Mains*, 10 to 6-in. c. i., 4 miles. *Services*, galv. i. Pipe and specials from McNeal Pipe and Foundry Co., Burlington, N. J.; trenching and pipe-laying done by the day. *Taps*, 128. *Meters*, not given. *Hydrants*, Holyoke, 45. *Valves*, Ludlow.

Pressure, 125 to 152 lbs.

Financial.—Cost, $35,000. Bonded debt, $35,000. Int., 4%. Authorized bonds, $40,000.

Management.—Comrs.: G. T. Plunkett, O. E. Maxwell, E. Fremain. Report by former; date, Feb. 28, '90.

HOLBROOK, *Norfolk Co.* (Pop. 2,130; est., 3,500.) No sewers or electric lights.

History.—Built in '87-8 by town. The stand-pipe and pumping station, and mains between, are owned jointly by Holbrook and Randolph and operated as Randolph and Holbrook Water-Works under one management.

Water Supply.—Lake in Randolph and Braintree, by pumping to stand-pipe.

Pumping Machinery and Stand-Pipe.—See Randolph.

Distribution. *Mains*, 12 to 6-in. c. i., 9 miles. *Services*, w. i. and cem. *Taps*, 270. *Meters*, none. *Hydrants*, Chapman, 63. *Valves*, Chapman.

Consumption, see Randolph. *Pressure*, 78 lbs.

Financial.—Cost, $92,717, including $60,832, ½ cost of joint works. Debt not given. Int., 4%. Sinking fund, $4,700. Ann. op. exp., withheld, est., $2,000. Ann. rev.: consumers, $3,143; city, $2,500. Hydrant rental, $25.

Management.—Three Comrs.: Prest., W. F. Gleason; Secy., Frank G. Morse; Supt., E. J. Chadbourn.

HOPEDALE, *Worcester Co.* See Milford.

HOLYOKE, *Hampden Co.* (Pop., 21,915; est., 35,000.) On west bank of Connecticut river, at point where river falls 50 feet in ¾ miles, affording water-power that was developed for manufacturing in '49. City is laid out regularly on high ground. Incorp. as West Springfield in 1786, as a separate town in '50, and as city in '73. Has sewers and electric lights.

History.—Built in '73 by city, when population was 14,000. Consulting Engrs., Shedd & Sawyer, Boston. Const. Engr., original works, E. C. Chase, Northampton; extensions, E. A. Ellsworth.

Water Supply.—Wright's and Ashley's ponds, by gravity. Ponds are 3½ miles from city, connected by canal and two mountain streams; area of two, 230 acres; drainage area, 2.7 sq. m. of hilly land composed of gravel and ledges of slate and trap-rock. Ponds are fed by large subterranean springs.

Dams and Reservoirs.—Cap., not given. *Dam at outlet of ponds :* Stone, raising water 7 ft. above natural level; cost, $14,000. *Tannery brook dam :* not described. *Whiting street dam and storage reservoir :* Cap., not given; area flooded, 114 acres ; dam of rubble masonry, 1,900 ft. long, 10 to 30 ft. high, 7 ft. wide on top. Built in '89. Engr., E. A. Ellsworth, Holyoke, Mass. *Bray brook dam and storage reservoir :* Cap., 70,000,000 galls.; area. 20 acres; dam, not described. In '81 small dam was built on Tannery, and in '84 another on Whiting street brook, to divert water to either Ashley's pond or conduit. In '84, storage reservoir was built on Bray brook, which empties into Ashley's pond.

Gate House.—Size, 18 x 24 ft.; at head of Wright's pond.

Conduit.—From gate-house at Wright's pond to city; 18,979 ft. long; 1,647 ft. of 20-, 17,332 ft. of 16-in. c. i.

Distribution.—*Mains*, 20 to 4-in. c. i., 45 miles. *Services*, w. i. and cem., enam. and rubber lined iron. Pipes and specials from Jesse W. Starr & Sons, Camden, N. J.; laid by E. B. Allen & Co., New Britian, Conn. *Taps*, 2,285; '88 MANUAL should have read 2,713, instead of 2,718. *Meters*, Worthington, Crown, Ball & Fitts and Desper, 143. *Hydrants*, Ludlow, Chapman, Holyoke and Mathews, 288. *Valves*, kind, do., and Eddy. *At close of '80 there were :* Mains, 25 miles. Taps, 1,140. Meters, 59. Hydrants, 149.

Consumption, est., 2,380,000 galls. *Pressure*, 72 lbs.

Financial.—Cost, $513,663. Bonded debt, $250,000. Int., 6%. Sinking fund, $110,072. Ann. op. exp., $10,340. Ann. rev.: consumers, $55,677; city, $3,278. Hydrant rental, $3,000 allowed for fire purposes, or about $10.40 each. Cost, Dec. 31, '80, $312,142; Rev. for '80, for water, $39,363.

Management.—Three Comrs. Chn., Maurice Lynch. Secy., Moses Newton. Registrar, E. P. Clark. Supt., Jno. D. Hardy. Inspector, E. M. Bolton.

HOPKINTON, *Middlesex Co.* (Pop., 4,607; est., 3,922.) Manufactures boots. Incorp. No sewers or electric lights.

History.—Built in '84 by town. Engr., C. H. Pierce, Providence, R. I. Contr., John T. Langford, Boston. In Apr., '89, the town voted to extend mains to supply Woodville, 2½ miles distant, but owing to opposition nothing further had been done Sept. 9, '89.

Water Supply.—Four artesian wells, pumping to tank. Wells are respectively, 75, 65, 57 and 119 ft. deep, 73 ft. of first, 57 of second, 37 of third and 112 ft. of fourth being forced through solid rock; fourth well is 8 ins. in diam.

Pumping Machinery.—Dy. cap., 50,000 galls; Deane.

Tank.—Cap., 250,000 galls.; 35 x 35 ft.; iron; located 142 ft. above lowest part of town.

Distribution.—*Mains*, c. i., 4¼ miles. *Services*, w. i. *Taps*, 355. *Meters*, 7. *Hydrants*, kind not given, 34. *Valves*, Chapman.

Consumption, 40,000 galls. *Pressure*, 80 lbs.

Financial.—Cost, $35,000. Debt, $32,743. Int., 4%. Sinking fund, $3,800. Ann. op. exp., $9,000. Ann. rev.: consumers, $2,000; city, $1,000. Hydrant rental, $25.

Management.—Comrs.: Henry McFarland, J. A. Woodbury.

HOUSATONIC, *Berkshire Co.* (Pop., est., 1,500.) Has some manufactories. Not incorp. No sewers or electric lights.

History.—Built in '88 by Housatonic Water Co.; put in operation Dec. 1, '88. Des. Engr., Garwood Ferris, Jersey City, N. J. Const. Engr., T. Z. Potter, Housatonic.

Water Supply.—Long Lake, with area of 160 acres, by gravity.

Distribution.—*Mains*, c. i., 6 miles. *Services*, galv. i. Pipe and specials from M. J. Drummond, N. Y. City; trenching and pipe-laying done by Ferris & Halladay, Jersey City, N. J. *Taps*, 70. *Meters*, Crown, 2. *Hydrants*, New York, 16. *Valves*, Ludlow.

Consumption, not determined. *Pressure*, 75 lbs.

Financial.—Cost, $60,500. Cap. stock, $40,000. Bonded debt, $40,000. Int., 6%. Hydrant rental, $40.

Management.—Prest., M. J. Drummond, N. Y. City. Treas., O. C. Houghtaling. Supt., T. Z. Potter.

HUDSON, *Middlesex Co.* (Pop., 3,739; est., 4,000.) Engaged in manufacturing shoes and rubber goods. No sewers. Has electric lights.

History.—Built in '84 by town. Engr., M. M. Tidd, Boston. Contrs., Goodhue & Birnie, Springfield.

Water Supply.—Gates pond, by gravity. Area of pond, 75 acres.

Distribution.—*Mains*, w. i. and cem., 11 miles. *Services*, w. i. and cem. *Taps*, about 500. *Meters*, 1. *Hydrants*, Chapman, Holyoke, 85. *Valves*, Chapman, Holyoke.

Consumption, about 100,000 galls. *Pressure*, 55 lbs.

Financial.—Cost, $88,927. Debt, $80,927. Int., 4%. Sinking fund, none; debt payable in annual installments. Ann. op. exp., about $3,800. Ann. rev.: consumers, $5,600; city, $1,500. Hydrant rental, about $17.60.

Management.—Three Comrs.: E. M. Stone, H. C. Tower, and Supt., D. W. Stratton.

HULL, *Plymouth Co.* See Hingham.

HYDE PARK, *Norfolk Co.* (Pop., 7,088; est., 10,000.) Engaged in manufacturing paper, cotton and woolen goods, curled hair and machinery. Incorp. No sewers. Has electric lights.

History.—Built in '85 by Hyde-Park Water Co. Engr., M. M. Tidd, Boston. Contr., Jno. T. Langford, Boston.

Water Supply.—Driven wells, pumping to reservoir. About 100 wells, 2 ins. in diam., and from 25 to 38 ft. deep, are connected with suction pipe. Contr., Calvin Horton & Son, Somerville.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Blake, working against 220-ft. head.

Reservoir.—Cap., 1,500,000 galls. Contrs., Willcutt & Perkins, Boston.

Distribution.—*Mains*, 16 to 4 in. c. i., 23 miles. *Services*, w. i. and cem. Pipe and specials from R. D. Wood & Co., Philadelphia, Pa. *Taps*, 1,150. *Meters*, 40. *Hydrants*, Chapman, 104. *Valves*, Chapman.

Consumption, not given. *Pressure*, 86 lbs.

Financial.—Cost, $200,000. Cap. stock, (in '88) $100,000. Debt, not given. Ann. op. exp., withheld, est., $4,000. Ann. rev.: consumers, withheld, est., $17,000; city, about $5,000. Hydrant rental, $50.

Management.—Prest., Robt. Bleakie. Treas. and Clerk, C. F. Allen. Supt. A. S. Adams.

KINGSTON, *Plymouth Co.* (Pop., 1,524; est., 1,572.) On irregular ground; settled in 1630; incorp. No sewers or electric lights.

KINGSTON AQUEDUCT ASSOCIATION.

General Description.—For domestic use, only, introduced in '04, after plans by Barstow Cook. Water was pumped to reservoir at the height of 100 ft. from hillside spring. Pump had 3½-in. bore, 11-in. stroke, and was driven by water-power. There were two miles of pipe supplying 50 families. Pipe was first of wood, then iron, then lead. These works were bought by city in '88. For further details see Tenth Census, U. S., Vol. XVII., Water Supply of Cities, pp. 199, 200.

PRESENT WORKS.

History.—Built in '86 by town. Des. Engr., A. H. Howland, Boston. Const. Engr., W. C. Boyce, Worcester.

Water Supply.—Well and river, by direct pumping, surplus water passing to reservoir. Well is brick-lined, 20 ft. in diam., and 18 ft. deep; yields about 70,000 galls. a day.

Filter Gallery.—Built in '88, along bank of river, connecting with well; brick, arched, 20 ins. wide, 14 ins. high, 361 ft. long.

Pumping Machinery.—Dy. cap., 328,320 galls.; Blake dup. water-power, with 5-in. cylinders of 12-in. stroke. *Water-wheel:* 30-in. Burnham turbine, 17 H. P.

Reservoir.—Cap., about 265,000 galls.; brick, with concrete bottom, 50 ft. in diam., and 18 ft. deep.

Distribution.—*Mains*, c. i., 8 miles. *Services*, lead. Mains from McNeal Pipe & Foundry Co., Burlington, N. J., and services from Chadwick Lead Works, Boston. Pipe laid by Thos. F. Maney & Co., Boston. *Taps*, 202. *Meters*, none. *Hydrants*, Coffin, 58. *Gates*, Coffin.

Consumption, 25,000 galls. *Pressure*, 65 lbs.

Financial.—Cost, about $43,000. Debt, $40,000. Int., 4%. Sinking fund, $1,500. Ann op. exp., $1,200. Ann. rev.: consumers, about $1,500; city, $108.

Management.—Three Comrs.: G. Evans, H. K. Keith.

LANCASTER, *Worcester Co.* (Pop., 2,003; est., 2,500.)

History.—Built in '85 by Lancaster Water Co., under 15-years franchise. Engr. and Contr., J. T. Langford, 70 Kilby St., Boston.

Water Supply.—Clinton Water-Works, town of Clinton superintending works and collecting rates.

Distribution.—*Mains*, 8 and 6-in. c. i., 8 miles. *Services*, w. i. and cem. *Taps*, 100. *Meters*, Crown, 10. *Hydrants*, Chapman, 25. *Valves*, Chapman.

Consumption, not given. *Pressure*, 100 lbs.

Financial.—Cost, $40,000. Cap. stock, $20,000. Bonded debt, $20,000. Int., 5%. Ann. op. exp., withheld, est., $1,000. Ann. rev.: consumers, withheld, est., $2,000; city, $1,250. Hydrant rental, $50. No further financial data given.

Management.—Prest., E. V. R. Thayer. Treas., J. T, Langford, Boston. Supt., J. F. Philbin, of Clinton Water-Works.

NOTE.—Above data is substantially that given in '88 MANUAL, but Co. say "no change from last report."

LAWRENCE, *Essex Co.* (Pop., 39,151 ; est., 40,000.) On Merrimack river. Founded in '45 as manufacturing town, river affording excellent water-power. Has sewers and electric lights.

History.—Built in '73-5 by city, population in '70 being about 30,000. Des. Engr., L. F. Rice. Consulting Engr., Jas. P. Kirkwood, Brooklyn, N. Y. Chf. Engr. of Const., Walter F. McConnell, Boston. Supplies Methuen.

Water Supply.—Merrimack river, pumping to reservoir and direct. Drainage area, 4,136 sq. m.

Intake Pipe.—A 36-in. c. i. pipe has its inlet-end cased in stone masonry at point in river where water is about 12 ft. deep. Pipe extends 132 ft. to brick conduit 38 ft. long, connecting with chamber discharging into pump-well.

Filter Gallery.—Near river bank, 300 ft. long, with bottom 15 ft. below surface of river; has rubble masonry walls 4 ft. high and 8 ft. apart, and is covered with semicircular brick arch. At bottom are cross braces of granite, 1 ft. sq. and 10 ft. apart, filled between with broken stone. Sand and gravel are placed above. In '76, canal was cut between gallery and river, which increased supply somewhat. Canal and gallery are cleaned each year. Both filter gallery and river inlet discharge into a chamber from which water is delivered to pump-well. Water can be taken either from filter gallery or direct from river, or both at once, as may be desired.

Pumping Machinery.—Dy. cap., 10,000,000 galls.; two 5,000,000 Leavitt, built in '75 by I. P. Morris & Co., at Port Richmond Iron Works, Philadelphia, Pa.

Buildings and Chimney.—See MANUAL for '88.

Force Main.—To reservoir; 30-in. c. i.; 5,000 ft. long, passing for 900 ft. through egg-shaped tunnel of hard burned brick laid in cement, 6 ft. high and 7 ft. wide, with well and manhole at each end. Just after entering reservoir a 20-in. branch leads from force to distributing main, with which it is connected in such a way that direct pumping can be used, or water pumped directly into gate-chambers for distribution without pumping against head of water in reservoir. Head, 180 ft. on pumps.

Reservoir.—Cap., 40,000,000 galls.; two compartments, each 375 x 338 ft., x 25 ft. deep. Built in excavation and embankment, latter being 27 ft. wide on top, with inner slopes 1½ to 1 and outer slopes 2 to 1, making base 125 ft. thick. Where needed for strength there are lower, supplementary banks, 20 ft. thick. Natural banks are lined with 2 ft. of puddle, and artificial banks have puddle wall in center, beginning from 8 to 10 ft. below bottom of reservoir, with width of 12 ft., being stepped 1 ft. in every 5 until within 2 ft. of the top of the bank. Bottom of reservoir is covered with 2½ ft. of puddle, above which is first layer of gravel, then round cobble stone paving. Slopes are paved with rubble stone, upon layer of crushed stone.

The force main extends upwards through central bank, or dividing wall, of reservoir, turns, and discharges water through bell-shaped pipe upon stone platform from which water falls over 6 granite steps, 10 feet wide, into each compartment of reservoir, or by use of flash boards, into but one compartment. This method breaks up water, and causes it to be aerated.

Gate-House.—Brick, 30 ft. sq., 20 ft. high, with granite foundations beginning, 11 ft. below bottom of reservoir, where they are 40 ft. sq. In gate-house are one large

and two small wells, into which water is brought from reservoir. These are connected with distribution mains by two 30-in. pipes carried through gate-vault and tunnel and uniting in a T joint.

Distribution.—*Mains*, 30 to 6-in. c. i., 55 miles. *Services*, lead. *Taps*, 4,682. *Meters*, principally Crown, Union and Worthington, 1,050. *Hydrants*, Lowry, 500. *Valves*, Chapman, Whittier. *At close of* '80: mains, 49.7 miles. Taps, 3,011. Meters, 209. Hydrants, 461.

Consumption, 2,667,259 galls. *Pressure*, 70 lbs.

Financial.—Cost, $1,983,325. Debt, $1,300,000. Int., 6%. Sinking fund, $404,894. Ann. op. exp., $18,410. Ann. rev.: consumers, 79,436. Cost of original works, $1,200,000; to Dec. 31, '80, $1,659,138. Rev., for '80, $61,273; for '87, $79,459, instead of $89,459, as given in '88 MANUAL.

Management.—Five Comrs. Prest., Jno. Breen. Clerk and Supt., A. H. Salisbury.

NOTE.—For more extended description see *Eng. News*, vol. V., pp. 283, 291, 300. Some further details are also given in Tenth Census, U. S., Vol. XVII., Water Supply of Cities, p. 249.

LEE, *Berkshire Co.* (Pop., est., 1,500.) On Housatonic river, on very irregular ground. Settled in 1760; incorp. town in 1776. No sewers. Has electric lights.

History.—Built for domestic supply in '81 by Berkshire Water Co. Contrs., Goodhue & Birnie, Springfield, Mass.

Water Supply.—Mountain stream, by gravity from impounding reservoir. Stream has drainage area of 6 sq. mi.

Reservoirs.—Combined cap., 21,500,000. *Impounding:* cap., 20,000,000 galls.; area, 22 acres; max. depth, 8 ft. *Distributing:* cap, 1,500,000 galls; max. depth, 20 ft.; 212 ft. above village.

Distribution.—*Mains*, w. i. and cem., 3 miles. *Services*, w. i. *Taps*, 150. *Meters*, 1. *Hydrants*, kind not given, 16.

Consumption, unknown *Pressure*, 85 lbs.

Financial.—Cost, $30,000. Cap. stock, $20,000. Bonded debt, $20,000. Int., 6%. Ann. op. exp., $400. Ann. rev.: consumers, $2,500; city, $400. Hydrant rental, $25.

Management.—Prest., C. L. Goodhue, Springfield. Secy., R. D. Anable, Treas., Thos. N. Birnie, Springfield. Supt., J. C. Chaffee.

LEEDS, *Hampshire Co.* See Northampton.

LEICESTER; *Worcester Co.* (Pop., est., 1,000.) Incorp. a water supply district. No sewers. Has electric lights.

History.—Begun in '89, under construction in '90, by water supply district. Engr., Frank L. Fuller, 12 Pearl St., Boston. Contr., Thos. Hennessy, Holden.

Water Supply.—Springs and collecting wells, by gravity, with compensating stand-pipe. Wells in Paxton, 4¾ miles from center of village.

Stand-Pipe.—Probably 40 ft. high.

Distribution.—(As designed.) *Mains*, 12 to 4-in. c. i., including supply main, 10.51 miles. Mar. 1, '90, 3,900 ft. had been laid. *Hydrants*, 43.

Fianancial.—Cost, est., $75,000 for completed works. Authorized bonded debt, $75,000.

Management.—Comrs.: H. O. Smith, H. L. Watson, W. F. Whittemore. Reports by H. O. Smith and F. L. Fuller; dates, Jan. 25 and Mar. 1, '90.

LENOX, *Berkshire Co.* (Pop., 644; est., 700.) On a hill, 1,200 ft. above tide level, in center of Housatonic valley, surrounded by mountains. Settled about 1760 in corp. town in 1767. Has electric lights.

History.—Built in '75 by Lenox Water Co. Engr., Geo. Murdock.

Water Supply.—Springs and river, by gravity, from impounding reservoirs, and by pumping to reservoirs in case of need.

Dams and Reservoirs.—Combined cap., 605,000 galls.; three stone dams, laid in cement, form as many reservoirs, holding 40,000, 500,000 and 165,000 galls., respectively. Last is 100 ft. above village and is used as distributing reservoir.

Filters.—Stone and gravel.

Pumping Machinery.—Dy. cap., not given; Cameron; lifts water 190 ft. from river to reservoir.

Distribution.—*Mains*, c. i., 8 miles. *Services*, w. i. *Taps* (in '87), 150. *Meters* none. *Hydrants*, kind not given (in '87), 8.

Consumption, 45,000 galls. *Pressure*, 59 lbs.

Financial.—(In '87.) Cost, $26,000. Cap. stock, $22,000. Debt, none. Ann. op exp., withheld, est., $800. Ann. rev., consumers, withheld, est., $1,500. Hydrant rental, free.

Management.—Prest., Wm. R. Robeson. Secy., Edw. McDonald. Treas., Wm. D. Curtis. Supt., Chester R. Bond.

NOTE.—*The Co. ignored all inquiries* sent in '89. Most of above data is from the '88 MANUAL, but officers have been corrected to date.

LEOMINSTER, *Worcester Co.* (Pop., 5,772; est., 6,000.) On Nashua river and Monoosnock brook, on undulating ground, eastern portion being sandy and western hilly. Manufactures paper, jewelry, buttons, pianos and horn combs. Settled in 1725; incorp. in 1740. Partially sewered. Has electric lights.

History.—Built in '73 by town. Des. and Consult. Engr., Phineas Ball, Worcester. Engr.-in-charge, C. E. Lund, deceased, Concord, N. H. Contrs., Goodhue & Birnie, Springfield, Mass.

Water Supply.—Morse and Haynes brooks, by gravity, from impounding and distributing reservoirs. Brooks have combined drainage area of 1,215 acres.

Dams and Reservoirs,—Combined cap., probably about 160,000,000 gals.

Haynes Dam and Reservoir: cap., 120,973,000 galls.; area flooded, 57.85 acres. Dam of puddled gravel with heart-wall of stone in cement; 693 ft. long, 15 ft. high, 22 ft. wide on top; inner slope, 2 to 1, paved with about 12 ins. of cobble stone. *Heart-wall:* stone, in cement, about 3 ft. thick. *Spillway:* at south end, excavated in earth, lined with stone; free; slope, ¼ in. to 1 ft. *Discharge-pipe:* 14-in. Dam does not leak. Built in '73. Engr. and Contr., see History. Cost, together with distributing reservoir, $25,000.

Morse Dam and Reservoir: Cap., unknown; area flooded, about 10 acres. Dam originally built for water-power; gravel, about 100 ft. long, 12 ft. high, 12 ft. wide on top. *Spillway:* Plank-lined, free; slope, 3 ins. to 1 ft. *Discharge-pipe:* 10-in. Dam does not leak. Built by G. & A. Morse, now owned by town. Date and cost not given.

Dam and Distributing Reservoir: Cap.. 6,766,000 galls.; area flooded, 4.55 acres; on brook below one of storage reservoirs. Dam of gravel, with heart-wall of stone in cement; 304 ft. long, 23 ft. high, with inner slope 2 to 1, paved. *Heart-wall:* stone in cement about 3 ft. thick. *Spillway:* at south end, excavated in earth, lined with stone, free; slope, drops about 10 ins. every 20 ft. *Discharge pipes:* two 14-in, taking water from gate-house at foot of inner slope of dam. Dam does not leak. Built in '73. Cost, see Haynes dam. Engr. and Contr., see History.

Distribution.—*Mains*, 12 to 14-in., c. i., w. i. and cem., 22.8 miles. *Services*, w. i. and cem. *Taps*, 997. *Meters*, none. *Hydrants*, kind not given, 145. *Valves*, Ludlow. *Close of* '70: Mains, 17.8 miles. Taps, 503. Meters, none. Hydrants, 110. *Close of* '80: Mains, 19.8. Taps, 546. Meters, none. Hydrants, 126.

Consumption, unknown. *Pressure*, 80 to 125 lbs.

Financial.—Cost, $189,298. Debt, $160,000: $50,000 at 7, $10,000 at 6, $100,000 at 4%. Sinking fund, none. Ann. op. exp., $2,000. Ann. int., $8,679. Ann. rev.: consumers, $13,883; city, $7,117. Hydrant rental, $50. First cost, $160,000; to Dec. 31, '80, $170,000. Net income to Mar. 1, '89, $53,260.

Management.—Comrs. Prest., Hamilton May. Secy., Geo. Hall. Treas. and Supt., J. G. Tenney.

LEXINGTON, *Middlesex Co.* (Pop., 2,400; est., 2,800.) Not incorp. No sewers or electric lights.

History.—Built in '84 by Lexington Water Co. Engr., Moses Joy, Jr., Milford.

Water Supply.—Ground water, pumping to tank.

Pumping Machinery.—Dy cap., 600,000 galls.; Blake dup.

Tank.—Cap., 82,000 galls.; 20x35 ft.; from H. B. Bigelow & Co., New Haven, Conn.

Distribution.—*Mains*, c. i., 9½ miles. *Services*, lead. Pipes and specials from Warren Foundry & Machine Co., Phillipsburgh, N. J., and A. H. McNeal, Burlington, N. J. *Taps*, 335. *Meters*, 1. *Hydrants*, Ludlow, 50. *Valves*, Ludlow.

Consumption, 75,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 80 lbs.

Financial.—Cost, withheld, est., $100,000. Cap. stock (in '88), $60,000. Bonds (in '88), $20,000. Ann. op. exp., withheld, est., $1,500. Ann. rev.: consumers, withheld, est., $6,400; city, $1,600. Hydrant rental, $33.33 for first 30; additional, $30.

Management.—Prest., Moses Joy, Jr., Milford. Secy., C. E. Tingley, 105 Summer St., Boston. Supt. and Treas., E. L. Wires, 105 Summer St., Boston.

LINCOLN, *Middlesex Co.* (Pop., 907; est., 900.) In hilly, agricultural region 14 miles from Boston. Settled in 1747; incorp. village in 1754. No sewers or electric lights.

History.—Built in '75 by town. Engr., M. M. Tidd, Boston.

Water Supply.—Sandy pond, pumping to reservoir. Pond has area of 152 acres.

Pumping Machinery —Dy. cap., 100,000 galls.; Worthington dup. *Boiler:* locomotive.

Distribution.—*Mains*, w. i. and cem., 35 miles. *Services*, w. i. and cem., *Taps*, 35. *Meters*, none. *Hydrants*, Newport, 11.

Consumption, unknown. *Pressure*, not given.

Financial.—Cost, $31,000. Debt, $30,000. Int., 6%. Ann. op. exp., $651. Ann. int., $1,800. Ann. rev.: consumers, $819; city pays int.

Management.—Secy. and Supt., Geo. L. Chapin.

LOWELL, *Middlesex Co.* (Pop., 59,475; est., 70,000.) On Merrimack river. Business part of city is low and flat, but environs are elevated. At this point river descends rapidly, bringing down drainage of 4,135 sq. m. and affording most excellent water-power, which is used for various manufactories; largest cotton mills in United States are here. First mill was erected in '22, and city was incorp. in '36. Has sewers and electric lights.

History.—Built in '72 by city, pop. in '70 having been 40,000. Des. Engr., Jos. P. Davis. Const. Engr., Geo. E. Evans. Asst. Engr., Jas. H. Harlaw, Pittsburg, Pa., Before construction of these works several lines of w. i. and cem. pipe had been laid by city for fire protection, and these were incorporated in distribution system.

Water Supply.—Merrimack river, filtered, pumping to reservoir. Water is taken from river about 1¼ miles above center of city, and 1,500 ft. above Pawtucket dam.

Filter Galley.—Excavated in gravel and sand when works were built; bottom, area 10,400 sq. ft.; parallel to and 100 ft. from river, 1,300 ft. long, 8 ft. wide. Rubble masonry walls, in cem., 2¾ ft. thick and 5 ft. high support semicircular arch, 1 ft. thick, of brick in cement. The intrados at crown is on level with top of Pawtucket dam. At bottom are cross braces of granite, 1 ft. sq., placed 10 ft. apart and filled between with coarse screened gravel. Three manholes are carried to surface of ground above. Ground water from narrow tract of intervale land from 300 to 3,000 ft. wide, underlaid with mixed stratum of gravel and sand, enters gallery from bottom, this having been intended as an addition to supply originally coming from river. Water can be drawn directly from river through a 30-in. c. i. pipe leading to inlet chamber 17½ x 38½ ft., with wing 13½ x 15½ ft.; walls of cut granite in cem. Inlet pipe is 220 ft. long, extends 45 ft. into river, where it is strapped to grillage of piles. A screen and gate is placed at outer end and second gate 136 ft. from chamber. In '73 it was found, by tests, that dy. yield of filter gallery was 150 galls. per sq. ft. of bottom area. Until '74, supply from gallery was sufficient, but in Aug., '74, after constant pumping for 31 days, supply was exhausted, the dy. yield having been 940,000 gals. May 10, '75, supply again ran short, the dy. yield being 960,000 galls., or 92.3 galls. per sq. ft.; the river was somewhat higher than in previous fall. The av. dy. consumption in '75 was 1,219 225 galls., or over 25% greater than yield of gallery. It was decided to construct a filter bed.

Filter Bed.—Built in '76, between filter gallery and river; filtering material, 8 ft. of stone and gravel; 100 x 114 ft. on bottom, which is 8 ft. below level of Pawtucket dam; bottom area, 11,400 sq. ft. Dry stone drains rest on gravel bottom, beneath filtering material. Main drain is 15 ins. sq. at river end, 100 ft. long, and 30 ins. sq. at well, connecting with gallery; 27 lateral drains slope to the main drain, and are each 8 x 12 ins.; total length, 1,350 ft.

In the spring of '77 freshet deposited 18 ins. of sand and silt on filter bed, and it was necessary to admit some water directly from river until deposit was removed in Sept., when for 83 days the filter bed and gallery yielded the full supply to the city of 1,750,800 galls. In '78, filters furnished the full dy. supply of 1,879,810 galls. for 43 days—a dy. yield per sq. ft. of about 165 galls. It was found that with a 1-in. silt deposit the filter yielded but little water. From Aug., '78, to June, '79, surface of the bed was not cleaned, and in this time 20 ins. of silt had accumulated. After being cleaned it supplied gallery for only 9 days before another inch of silt entirely stopped the yield. Finding that the bed needed cleaning three times a month, that the cost would be $25 each time, and that it could only be done when river was low and free

from ice, further cleaning was given up. Until '88, when the new inlet was put in and the bed cleaned, it was practically useless, four-fifths of water used being pumped directly from river.

When the new inlet was put in, in '88, silt to a depth of from 2 to 3 ft. was removed. Cost, $168. Subsequent cleanings cost less than $6.75 each. The bed was cleaned 5 times in '88: May 28, June 25, July 14, Aug. 13, Sept. 14. After first cleaning all water pumped in 24 hours, 5,280,000 galls. was obtained from bed, but at end of the first day it was necessary to open 1 in. the gate of the pipe connecting directly with river; after few days this was opened still more, but never more than 3 ins. After each cleaning similar results followed. Previous to introduction of new inlet and cleaning of bed, river-gate had been open 6 ins. After last cleaning in '88, river overflowed banks of inlet, covering the bed with silt and mud, and as water continued high, filter was useless during remainder of year. This could be avoided by raising river-wall.

Conduit.—Leading from filter galleries and inlet-chamber to engine-house. First 4,182 ft. is a 51-in. circular brick conduit, 8 ins. thick, laid in cement. Of this, 1,788 ft. is through rock tunnel, 4 ft. sq., lined with brick for 733 feet. This brick conduit terminates in chamber, 15½ x 11 ft., covered by an octagonal brick gate-house; from this chamber a 30-in. c. i. pipe is laid 6,554 ft. to engine-house. To this point the fall is 9 ins. per 100 ft. Pipe crosses Beaver brook by means of an inverted syphon 100 ft. long, laid 4 ft. below bed of stream, and about 13 ft. below its surface. This was laid by means of a coffer-dam. At the lowest point in pipe conduit there is a manhole 14 ft. long with a 6-in. blow-off pipe 3½ ft. below its top. The pipe-conduit terminates in arched pocket, 35½ x 10 ft., over which is the foundation for the pumping engine, the whole resting partly on timber foundations and partly on rubble masonry supported on 82 piles driven 20 ft. A passage in engine foundation leads from pocket to pump-well, which is 13 x 25 ft., x 18.17 deep.

Pumping Machinery.—Dy. cap., 10,750,000 galls.; Morris and Worthington. First pumping engine was made by Henry P. Morris and was a beam and fly-wheel comp., cond. engine, with low-pressure cylinder of 57-in. diam. and 96-in. stroke, and high-pressure cylinder of 36-in. diam. and 61⅜-in. stroke; pump is a Thames-Ditton, with 36-in. bucket and 25 x 45-in. plunger of 60-in stroke, and has dy. cap. of 5,000,000 galls. In '75 a 5,000,000 Worthington comp., dup. was erected.

Force Main.—C. i., 24 ins. in diam. and 2,666 ft. long. Head at pumps, 166½ ft.

Low Service Reservoir.—Cap., 30,000,000 galls.; within city limits, in excavation and embankment, 520 x 510 ft., x 24 ft. deep, having two corners cut off. Banks are 15 ft. wide on top. Area of high water surface, 5.2 acres; elevation, 181½ ft. above city datum. Inner slopes. 1½ to 1, covered with 2 ft. of puddle, 1 ft. broken stone, 15 ins. granite riprap with toe of 1½ ft. Outer slopes, 2 to 1. Bottom covered with 1 ft. of puddle.

Gate House: At foot of western embankment; cut granite, 26 ft. sq.; wall 3½ ft. thick divides it into influx- and efflux-chambers, and former is again divided in two parts and provided with weir to measure water pumped to reservoir. Water passes over weir to and through a 30-in. pipe to opposite side of reservoir; pipe supported by masonry piers. Sluice gate in wall between two chambers, 2½ x 3⅛ ft., provides for pumping directly to distribution system. Ordinarily water passes from reservoir to distribution system through efflux-chamber, there being two sluice gates, each 2½ x 3 ft., provided with screens in the reservoir wall of this chamber. One gate is above the other, to permit drawing from different levels. In '72 reservoir was emptied for cleaning for first time, when about 75 ft. of slope-paving fell in.

High Service Reservoir.—Cap., 1,324,000 galls.; 130 x 150 ft. at top of inner slope, and 16 ft. deep from high water mark, which is 4 ft. below top of inner slope. Slopes are first covered with 2 ft. of puddle, over which is 10 ins. of broken stone, and above this a 15-in. granite paving. Bottom is covered with 12 ins. of clay puddle, and a space around inlet pipe, 19 x 21½ ft., is paved and cemented. Built in '81.

Distribution.—*Mains*, c. i., 85.69 miles. *Services*, w. i., lead. *Taps*, 8,115. *Meters*, mostly Desper, Worthington and Crown, with a few Ball & Fittz and Duplex, 1,630. *Hydrants*, Ludlow, 823. *Valves*, Chapman.

Consumption, 4,978,000 galls. *Pressure*, 60 lbs.

Financial.—Total expenditures to Jan. 1, '89, $4,153,583. Total receipts, Jan. 1, '89, $2,070,187. Net cost, $2,383,396. Debt, $1,191,160. Int., 6%. Ann. op. exp., $14,431. Int. paid in '88, $111,045. Extensions, '88, $27,803. Total exp., '88, $183,280. Ann.

rev., receipts from all sources, $183,139. Hydrant rental, $12, reduced from $20, charged prior to '88. First cost, $1,266,766. Total cost to Jan. 1, '81, $2,310,424. Total exp., '80, $154,392, or, excluding int., $45,032. Total rev., '80, $123,740.

Management.—Five Comrs. Prest., Arnold S. Welch. Supt., Millard F. Wright. Secy., Chas. L. Knapp. Pumpg. Engr., Jas. P. Roberts.

NOTE.—Further details, especially regarding pumping machinery, and view of the Worthington pump, are given in the Tenth Census U. S., vol. XVII., Water Supply of Cities, pp. 114-117; also vol. XXII., Steam Pumps and Pumping Engines.

LUDLOW, *Hampden Co.* (Pop. of town, 1,526; est., 1,700.)

History.—Date built not given. Mains and hydrants, only, owned by Ludlow Mfg. Co. See Water Supply and Financial.

Water Supply.—Springfield Water-Works.

Distribution.—*Mains* and *Services*, not given. *Taps*, 180. *Meters*, not given. *Hydrants*, 17.

Consumption and *Pressure*, included in Springfield.

Financial.—Water for consumption supplied to Ludlow Mfg. Co. at 20% discount from Springfield rates; hydrants, $20 each. Other consumers pay regular rates. No other data.

Managment.—Ludlow Mfg. Co. and Springfield officials.

LYNN, *Essex Co.* (Pop., 38,274; est., 51,400.) On north side of Massachusetts bay, mostly on flat land, with marshes in front of it, and range of hills about 1½ miles in rear, spur from which enters city and rises to height of 185 ft. Great center of shoe manufacturing in United States. Settled in 1629; incorp. city in '50. Has sewers and electric lights.

History.—Built in '70-72 by city, when population was 30,000. Engr., Geo. H. Bishop, Middletown, Conn., for original works; for additional supply from Saugus river in '83-84, Phineas Ball, Worcester. Contr., Geo. H. Norman, Newport, R. I. Town of Saugus has its water supply from these works.

Water Supply.—Brooks, by gravity to pump-well, thence by pumping to reservoir. Storage reservoirs known as Breed's and Birch ponds have been built on two of the brooks. Total drainage area, 3,297 acres. The supply from Hawkes and Penny brooks, in N. Saugus, was introduced in '84; combined drainage area, 2,300 acres. In '88 construction of a storage reservoir was begun on Penny brook, to be known as Walden pond, and in '89, on Blood's swamp brook, to be called Glen Lewis pond.

Dams and Storage Reservoirs.—Combined cap., 600,000,000 galls.; area, 142 acres; drainage area, 997 acres. New reservoirs will have additional cap. of 466,000,000 galls. *Breed's pond:* area, 58 acres; drainage area, 575 acres. *Birch pond:* area, 84 acres; drainage area, 422 acres. *Dam No. 1:* Earth, with stone retaining wall on dry side; 300 ft. long, 23 ft. high, 15 ft. wide on top; inner slope, 1½ to 1, puddled with clay; retaining wall, 150 ft. long, 18 ft. high. Cost see No. 2. *Dam No. 2:* Dam of earth, with puddled clay heart-wall; 250 ft. long, 16 ft. high, 15 ft. wide on top; slope, 1½ to 1. Cost of dams No's 1 and 2, $75,595. *Walden pond:* See above. Engr., Geo. H. Bishop, Middletown, Conn. *Glen Lewis Pond.* See above.

Supply Conduits.—W. i. and cem., one 18-in., 2,228 ft. long; one 22-in., 5,233 ft. long. Av. head, 17 ft.

Pumping Machinery.—Dy. cap., 8,000,000 galls.: 5,000,000 Leavitt, 3,000,000 Deane; a Leavitt compound beam and fly-wheel engine, with 17½-in. cylinder for high-pressure and 36-in. for low-pressure, drives Thames-Ditton pump with 26.12-in. bucket and 18.5-in. plunger, each having an 84-in. stroke. The Deane comp., cond. pumping engine is kept for reserve and supplementary use.

Force Main.—A 20-in. w. i. and cement pipe, 1,904 ft. long.

Reservoir.—Cap., 20,000,000 galls. On Pine hill, 177 ft. above mean high tide, with 5 acres of water surface and depth of 15 ft.; built in excavation and embankment, with inner slopes puddled. Bottom, apparently being of water-tight material, was not puddled at first, but when reservoir was filled it leaked so badly that it was almost useless. In '73 it was made 3 ft. deeper and covered with 1 ft. of clay puddle. It was then divided by stone wall with rubble core. Outer slope has 12-in. paving on 15 ins. of rubble.

Distribution.—*Mains*, 16 to 4-in. w. i. and cem., 83 miles. *Services*, 2 to ¾-in. w. i. and cem. *Taps*, 8,233. *Meters*, 254. *Hydrants*, Whittier, 602. *Valves*, Whittier.

Consumption, 2,474,556 galls. *Pressure*, 54 to 65 lbs.

Financial.—Cost, $1,479,203. Debt, $1,422,500: $1,124,000 at 3½ to 6, $223,500 at 3½ to 4, $75,000 at 4 %. Sinking fund, $248,686.

RECEIPTS.		EXPENDITURES.	
Water, all purposes	$133,012	Management and repairs	$26,164
Summons, shutting off, etc.	228	Int. on bonds	67,308
Rent and Sundries	487	Damages to property	9,957
		Construction	6,994
Total revenue	$133,727		
Labor and material	6,994	Total expenditures	$110,423
Total receipts	$140,721		

Balance, receipts above expenses, $30,298. Hydrant rental, $20. First cost, $1,000,390. Total receipts, Oct. 1, '71, to Jan. 1, '72, $8,989; for '80, $79,635.

Management.—Water Board, 5 members. Prest., David Knox. Secy. and Supt., Jno. C. Haskell.

NOTE.—For further details regarding pumping machinery see Tenth Census U. S., Vol. XVII., Water Supply of Cities, p. 200.

MALDEN, *Middlesex Co.* (Pop., 12,017; est., 19,000.) On Malden river, tributary of Mystic river; southern part of village on level, and northern part on hilly ground. Engaged in manufacturing. Settled in 1634; incorp. No sewers. Has electric lights.

History.—Built in '69 by city. Engr., A. F. Sargent. Contr., Geo. H. Norman, Newport, R. I. In '83-9, works were extended as noted below, with M. M. Tidd as Engr.

Water Supply.—Spot pond, by gravity and additional pumping through standpipe; also supply introduced in '89 from driven wells, by pumping to tank. Pond at high water is 143, and at low water, 135 ft. above marsh level; has area of 296 acres, drainage area of 1,100 acres, and is owned by towns of Malden, Medford and Melrose, each of which draws its supply from it. Right to draw water from Martin's pond has been given by Legislature and accepted by town. There are 51 2½-in. driven wells in Eaton's meadow. Contr., B. F. Smith, Boston.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; Blake; old pump is a 1,000,000 single-acting; new, 2,000,000 comp., dup. A 1,000,000 Worthington has been connected with the the works, but is not in use *Boilers:* old, Whittier; new not given.

Gravity and Force Main.—*Old Supply:* 12-in.; length not given. *New supply*, c. i. 14 ins., 9,009 ft. long; laid by J. J. Newman, Providence, R. I.

Stand-Pipe.—Is 12 ins. in diam by 55 ft. high, 10 ft. having been added in '88 or '89; acts as water-cushion, and adds about 15 lbs. additional pressure to gravity supply.

Tank.—Cap., 1,096,000 galls.; w. i., 75 ft. in diam., 35 ft. high; top, 235 ft. above marsh level. Contrs., Cunningham Iron Works, Boston.

Distribution.—*Mains*, 12 to 4-in., cem.-lined sheet iron, 53.75 miles; beginning with '89 c. i. pipe will be used entirely. *Services*, lead. *Taps*, 3,777. *Meters*, principally Crown and Worthington, 53. *Hydrants*, mostly Chapman, 233. *Valves*, mostly Chapman.

Consumption, 1,000,000 galls. *Pressure*, 55 to 65 lbs.

Financial.—Cost, $510,020. Debt, $140,000; $200,000 to have been paid in '89. Int., 3½, 4, 5 and 6%. Sinking fund, $165,111. Ann. op. exp., $14,192. Ann. int., $24,575. Ann. rev.: consumers, $56,133. Hydrant rental, free, First cost, $350,000.

Management.—Three Comrs. Registrar, Geo. W. Barrett. Supt., Solon M. Allis. Inspector, Jno. N. Jordan.

MANSFIELD, *Bristol Co.* (Pop., 2,765; est., 2,950.) Manufactures straw hats, bonnets and jewelry. Incorp. as a water supply district. No sewers or electric lights.

History.—Built in '88 by Mansfield water supply district. Des. Eng., Percy M. Blake, Hyde Park. Const. Engr., L. L. Serry, Stoneham.

Water Supply.—Cate springs, pumping to stand-pipe and direct. There is a well 25 ft. in diam. by 20 ft deep, lined with brick in cement.

Stand-Pipe.—Cap., 242,000 galls.; 20x103 ft.; from E. Hodge & Co., East Boston.

Pumping Machinery.—Dy. cap., 600,000 galls.; two Blake comp., cond., dup. *Boilers:* Blake; two horizontal tubular, 4½x13 ft. 2 ins.; 72 3-in x 12-ft. tubes.

Distribution.—*Mains*, c. i., 6¼ miles. *Services*, not given. Pipe from Warren Foundry & Machine Co., Phillipsburgh, N. J.; laid by Jno. T. Langford, Boston. *Taps*, 128. *Meters*, 22. *Hydrants*, Ludlow, 46. *Valves*, Ludlow.

Consumption, 130,000 galls. *Pressure*, 30 lbs.

Financial.—Original cost, $37,159. Bonded debt, $69,000. Int., 4%. Sinking fund, $575. Ann. op. exp. and rev., not determined at time of report; est. for '89, exp., $1,750; rev., $5,150.

Management.—Three Comrs.: D. S. Spaulding, A. B. Day and W. B. Rogerson.

MARBLEHEAD, *Essex Co.* (Pop., 7,467; est., 7,550.) On Atlantic coast and is a summer resort. Manufactures shoes; engaged in fishing and seed growing. No sewers. Has electric lights.

History. Distribution put in in '87, by town; supply from July 1, '87 to Oct. 1, '89, from Marblehead Water Co. (see Swampscott.) In '89 town obtained its own supply and extended distribution. Des. Engr., W. J. Goldthwaite, Marblehead. Constr. Engr., Frank M. Fuller, Boston. Contr., in '87, Jno. T. Langford, Boston.

In '77 town laid 6,000 ft. 10-in. c. i. pipe for fire protection and street sprinkling.

Water Supply.—Driven wells, pumping to stand-pipe. Wells are in Salem, near town line.

Pumping Machinery.—Temporary plant in use Feb. 6, '90, with negotiations then pending for permanent pumps.

Stand-Pipe.—Height, 100 ft.; elevation above high water in wells, 177 ft.

Distribution.—*Mains*, 11 to 4-in. c. i., 6¼ miles Jan. 1, '89, 15 miles Jan. 1, '90. *Taps* (Jan. 1, '90), about 300. *Meters*, not given. *Hydrants* (Jan. 1, '90), Chapman, 159. *Valves*, Chapman.

Consumption, about 175,000 galls. *Pressure*, 55 to 75 lbs.

Financial.—Cost (Jan. 1, '90), $132,000. Bonded debt, do., $132,000. Int., 4%. Ann. op. exp. and rev., not given

Management.—Comrs. Chn., W. J. Goldthwaite. Supt., Thos. Main.

MARLBOROUCH, *Middlesex Co.* (Pop., 10,127; est., 12,000.) Engaged in manufacturing boots and shoes. Incorp. Sewers projected. Has electric lights.

History.—Built in '83 by town. Engr., M. M. Tidd, Boston.

Water Supply.—Lake Williams, pumping to reservoir and direct. Cap. of lake, about 270,000,000 galls; area, 72 acres; drainage-area, 291 acres.

Pumping Machinery.—Dy. cap., 2,500,000 galls.; Blake comp., cond.

Reservoir.—Cap., about 6,000,000 galls. 275 x 230 ft., x 18 ft. deep.

Distribution.—*Mains*, c. i., 25 miles. *Services*, w. i. and cem. *Taps*, 1,476. *Meters*, 104. *Hydrants*, Chapman, 245. *Valves*, Chapman.

Consumption, 292,000 galls. *Pressure*, 90 lbs.

Financial.—Cost, $252,764. Debt, $250,000. Int., 4%. Sinking fund, $27,788. Ann. op. exp., $4,694. Ann. int., $10,000. Ann. rev.: consumers, $17,917.

Management.—Three Comrs. Prest. and Secy., R. D. S. Mortimer. Supt., Geo. A. Stacey.

MAYNARD, *Middlesex Co.* (Pop., 2,291; est., 3,000.) On Assabet river. Has woollen mills. Incorp. No sewers. Has electric lights.

History.—Built in '89 by town, and put in operation about Nov. 1. Engr., M. M. Tidd, Boston.

Water Supply.—Receiving well, pumping to reservoir. Well has cap. of about 120,000 galls.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Blake comp., 80-ft. piston speed, 18-in. stroke; also high-pressure engine. *Boilers:* two tubular, steel.

Force Main.—Not described.

Reservoir.—Cap., not given; circular, rubble masonry in cement, with puddled earth embankments; depth, 25 ft. from bottom of reservoir to top of walls; diam., not given. Walls are 5 ft. thick at bottom and 2½ at top. Banks are 20 ft. thick at bottom and 8 at top.

Distribution.—(Nov. 1, '89.) *Mains*, 12 to 4-in. i., 4½ miles. *Hydrants*, 60. Consumption, not determined. *Pressure*, not given.

Financial.—Cost, about $75,000. Debt, about $70,000. Int., 4%.

Management.—Comr. Chn., Thos. Hillis. Treas., Wm. H. Gutteridge.

NOTE.—Other data not determined.

MEDFORD, *Middlesex Co.* (Pop. 7,573; est., 9,300.) On Mystic River, in valley surrounded by high hills; 5 miles from Boston; has some manufactories. Settled and incorp. as town in 1630. No sewers. Has electric lights.

History.—Built in '70 by city. Engrs., Shedd & Sawyer, Boston. Contr., Geo. H. Norman, Newport, R. I.

Water Supply.—Spot pond, by gravity, and pumping to reservoir when water n pond is low. Pond is owned by Medford, Malden and Melrose, and supplies each town ; area, 296 acres ; drainage area, 1,100 acres ; at high-water is 143, and at low-water, 135 ft. above marsh-level, and is about 130 ft. above town.

Settling Basin.—Not described.

Supply Main.—W. i. and cem., 14 and 12-in.

Pumping Machinery.—No data.

Reservoir.—Cap., 115,000 galls.; 120 x 23 ft.

Distribution.—*Mains*, w. i. and cem., 38½ miles ; water department has lined its pipes for 15 years. *Services*, w. i. and cem., galv. i. *Taps*, 1,882. *Meters*, 11. *Hydrants*, Chapman, Coffin, Whittier, 191. *Valves*, kind, do.

Consumption, 300,000 galls. *Pressure*, 50 lbs.

Financial.—Cost, $354,807. Debt, $300,000. Int., 6%. Sinking fund, $84,453, invested : $14,000 at 7, $42,000 at 6, $5,000 at 5, $12,000 at 4½ $10,000 at 4, and $1,452 at 2½%. Ann. op. exp., $6,418. Ann. int., $18,120. Construction, $4,782. New main to Winterhill, $790. Ann. rev.: consumers, $25,020; city, $3,000 Hydrant rental about $15.20.

Management.—Three Comrs. Chn., D. A. Gleason. Registrar and Clerk, C. B. Buss. Supt., R. M. Gow.

MELROSE, *Middlesex Co.* (Pop., 4,560; est., 7,100.) In valley surrounded by hills. Has large shoe factory and rubber works. Settled in 1650; incorp. town in '50. No sewers. Has electric lights.

History.—Built in '70 by city. Contr., Geo. H. Norman, Newport, R. I.

Water Supply.—Spot pond, by gravity and pumping to reservoir. Pond also supplies Malden and Medford; at high-water is 143, and at low-water 135 ft. above marsh-level and village; area, 296 acres: drainage area, 1,100 acres.

Intake.—Lake end attached to main pipe with swivel joint, to allow taking water at any depth, and raising for cleaning.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Knowles.

Reservoir.—Cap., 1,500,000 galls.; 145 ft. sq. at top, 94 at bottom, 17 ft. deep, 140 ft. above marsh-level.

Supply Main.—W. i. and cem., 16-in., 6,364 ft. long.

Distribution.—*Mains*, w. i. and cem., 26.8 miles. *Services*, cem. i. *Taps* 1,547. *Meters*, 4. *Hydrants*, kind not given, 132.

Consumption, unknown. *Pressure*, 75 lbs.

Financial.—Cost, $262,698. Debt, $217,000: $150,000 at 6, and $67,000 at 4%. Ann' op. exp., $9,650. Ann. int., $11,280. Ann. rev.: consumers, $21,688; city, $2,000 appropriated. First cost, $60,000. Rev. for water only in '70-1, $3,909; in '80, $9,822; in '85, $15,193.

Management.—Three Comrs.: Wilbur D. Fiske, Geo. L. Morse, Wm. H. Mills. Supt., Parker Merrill.

METHUEN, *Essex Co.* (Pop., 4,392; est., 4,550.) Engaged in manufacturing cotton and woolen goods, boots and shoes.

History.—Built in '76 by village for fire protection. **Water Supply.**—Lawrence water-works, by direct pumping. **Distribution.**—*Mains*, kind not given, 2½ miles. *Hydrants*, kind not given, 28. *Pressure*, not given. **Financial.**—Cost, $6,000. Debt, none. Ann. op. exp., not given, est. $500. **Management.**—Chf. Fire Dept., G. B. Bradbury.

MIDDLEBOROUGH, *Plymouth, Co.* (Pop. of fire district, est., 3,000.) On Nemasket river. Engaged in manufacturing. Incorp. a fire district. Partially sewered. Has electric lights.

History.—Built in '85 by fire district. Engr., Percy M. Blake, Hyde Park.

Water Supply.—Well, pumping to stand-pipe and direct. Well is in gravel beds underlying meadows adjoining Nemasket river; circular, 26 ft. in diam. by 22 ft. deep; heavy stone wall lined with 12 to 16 ins. of brick. Contrs. for well, Putterill & Killian, Boston. Supply is from well, direct, when engine is running, and at all other times from stand-pipe, which is at opposite end of distribution system, thereby causing water to pass through pipes from both directions, alternately.

Pumping Machinery.—Dy. cap., 1,728,000 gals.; two 861,000 Deane comp., cond. *Boilers*: Whittier, two tubular.

Engine-House.—Architect, Ernest N. Boyden, Boston. Contr., Q. A. Faunce, Quincy.

Stand-Pipe.—Cap., 235,000 galls.; 20 x 103 ft.; 8,907 ft. from top 108 ft. above, pumping station. Water pumped into top and drawn from bottom. Contr., H. S. Robinson, East Boston.

Distribution.—*Mains*, 10 to 6-in. c. i., 9.9 miles. *Services*, w. i. and cem. Pipe and specials from Warren Foundry and Machine Co., Phillipsburgh, N. J.; pipe laid by Chas. H. Eglee, Flushing, L. I. *Taps*, 412. *Meters*, 85. *Hydrants*, Ludlow, 79. *Gates*, Ludlow.

Consumption, 89,885 galls. *Pressure:* Ordinary, 45 to 60 lbs. Fire, 100 lbs.

Financial.—Cost, $81,584. Debt, $74,500. Sinking fund, $1,112. Int., 4%. Ann. op. exp., 3,039. Ann. int., $2,980. Ann rev.: consumers, $5,300; city, $2,500. Hydrant rental, no definite sum.

Management.—Three Comrs. Chn., E. P. Le Baron. Supt and Clerk, Jos. E. Beals.

MIDDLETON, *Essex Co.* See Danvers.

MILFORD and HOPEDALE *Worcester Co.* (Pop.: Milford, 9,310; est., 10,000. Hopedale, est., 2,000.) Milford is on Charles river, engaged in manufacturing machinery, boots and shoes, cotton and straw goods. Milford is incorp. Has sewers and electric lights.

History.—Built in '82 by Milford Water Co. Engr., Moses Joy, Jr. Contr., Geo. B. Inman, New York City.

Water Supply.—Charles river for fire purposes and wells for domestic use, by direct pumping. Wells 30 ft. deep and 23, 19 and 14 ft. in diam., respectively.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; 1,500,000 Holly, also Knowles pump. A 2,000,000 low-pressure comp., dup., was projected for '89. *Boilers:* One is a Holly.

Distribution.—*Mains*, 14 to 4-in. c. i., 19 miles. *Services*, lead. Pipe from McNeal Pipe & Foundry Co., Burlington, N. J.; Warren Foundry & Machine Co., Phillipsburgh, N. J.; R. D. Wood & Co., Philadelphia, Pa.; Donaldson Iron Co., Emaus, Pa.; Gloucester Iron Works, Philadelphia, Pa. *Taps*, 851. *Meters*, 67. *Hydrants*, Chapman, Ludlow, Mathews, 93. *Valves*, kind, do.

Consumption, 325,000 galls. *Pressure:* Ordinary, 80 lbs. Fire, 120 lbs.

Financial.—Cost, $271,000. Cap. stock, $150,000. Bonded debt, $100,000: $40,000 at 5½, $60,000 at 5%. Ann. op. exp. (in '87), $3,200. Ann. rev.: consumers (in '87), $15,000; city, $3,937. Hydrant rental, $46.66 for first 60, $30 for additional.

Management.—Prest. C. W. Shippee. Secy., F. J. Butcher, Hopedale. Treas., J. P. Daniels; Supt., Wm. H. Barney.

NAHANT, *Essex Co.* (Pop. 808; est., winter, 700; summer, 800.) On rocky peninsula on Atlantic coast; summer resort. Has sewers: no electric lights.

History.—Built in '85 by town. Engr., E. W. Bowditch, Boston.

Water Supply.—From Marblehead Water Co.'s system, through a meter. From '81 to '85 supply was from driven wells, owned by town, a temporary arrangement.

Distribution.—*Mains*, c. i., 8 miles. *Services*, w. i. *Taps*, 200. *Meters*, 6. *Hydrants*, Mathews, 52. *Valves*, Chapman.

Consumption, 30,000 galls. *Pressure:* Ordinary, 70 lbs. Fire, 90 lbs.

Financial.—Cost, 63,000. Debt and int. withheld. Ann. op. exp. withheld, est. $1,200. Ann rev: consumers, withheld, est., $5,000; city, not given.

Management.—Supt., R. L. Cochran.

NANTUCKET, *Nantucket Co.* (Pop., 3,727; est., 3,142.) On Island of Nantucket, on Nantucket Sound. Engaged in codfishing and coast trade. Summer resort. Settled over 200 years ago. No sewers or electric lights.

History.—Built in '78 by Wannacomet Water Co. Engr., Moses Joy, Jr., Boston.

Water Supply.—Wannacomet pond, pumping to tank and direct. Pond has area of 8 acres, drainage area of 40 acres, depth of 18 ft. in center, is two miles from town, between low hills, is 18 deep ft., and its surface is 6 ft. above sea-level.

Dam.—Not described. Cost, $2,500.

Conduit.—Of 8-in. c. i., 2 miles long: head, 104 ft.

Pumping Machinery.—Dy. cap., 1,800,000 galls.; Blake and Worthington duplex. Blake pump erected in '78; 8 x 10-in. steam; 6 in.-water cylinders. Worthington pump added in '80; 18½ x 10-in. steam; 14½-in. water cylinders.

Force Main.—Is 400 ft. long, 8-in., 38 lbs. pressure on pumps.

Tank.—Cap., 50,000 galls.; ¼-in. boiler i., 24 x 15 ft.; on 42-ft. iron trestle, located on hill with top elevation of 104½ ft. above sea-level.

Distribution.—*Mains*, 8 to 2-in. c. i., 8½ miles. *Services*, lead, galv. i. *Taps*, 501. *Meters*, none. *Hydrants*, Ludlow, 34. *Valves*, Chapman, Ludlow. *At close of* '80: Mains, 6 miles. Taps, 144. Meters, none. Hydrants, 4.

Consumption, 53,000 galls. *Pressure:* Ordinary, 35 lbs. Fire, 80 lbs.

Financial.—Cost, withheld, est., $100,000. Bonded debt, $20,000. Int., 6%. Ann. rev.: consumers in '87, $9,200; est., '88, $5,500; city, $848. Hydrant rental, $26.66 for first 30 and $12 for additional. First cost, $40,000. Rev. for '80, $1,400.

Management.—Prest., R. Gardner Chase, Boston. Secy., Treas. and Supt., Wm. F. Codd.

NATICK, *Middlesex Co.* (Pop., 8,479; est., 8,500.) On Charles river, 17 miles from Boston. Manufactures boots, shoes, baby carriages, wooden-ware and clothing. Incorp. in 1781. No sewers. Has electric lights.

History.—Built in '74 by city. Engr., M. M. Tidd, Boston. Contrs., Geo. H. Norman, Newport, R. I., and C. L. Goodhue, Springfield.

Water Supply.—Dug pond, by direct pumping and pumping to reservoir. Cap. of pond, 150,000,009 galls.; area, 44½ acres.

Pumping Machinery.—Dy. cap. 3,000,000 galls.; Worthington and Blake comp., dup., 1,500,000 galls. each.

Force Main.—Diam, 12 ins.; length, 12,000 ft.

Reservoir.—Cap., 3,500,000 galls.; in excavation and embankment, 175 ft. above pumps.

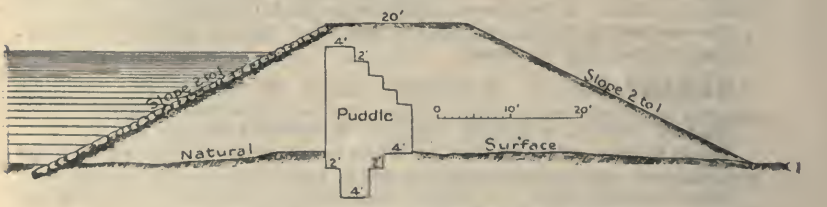
Distribution.—*Mains*, w. i. and cem., 27 miles; 26 miles 12 to 4-in., 1 mile 2 to 1-in. *Services*, galv. i. *Taps*, 1,347. *Meters*, 45. *Hydrants*, Pattee & Draper, 145. *Valves*, kind, do.

Consumption, 251,488 galls. *Pressure*, 60 to 90 lbs.

Financial.—Cost, $233,931. Debt, $115,700. Int., 4%. Sinking fund, $6,219. Ann. op. exp., $4,675. Ann. int., $4,628. Ann. rev.: consumers $15,520.

Management.—Three Comrs. Prest., F. Bigelow. Secy., G. W. Ingalls. Supt., J. W. Morse.

NEW BEDFORD, *Bristol Co.* (Pop., 26,845; est., 38,000.) On Acushnet river and Buzzard's bay, most of city lying on hillside, ascending gradually from tide-water to 100 ft. elevation. Western slope of city descends into Tripp's brook valley. Largely engaged in whale fishery and manufacturing cotton. Settled in 1650; incorp. town in 1787, city in '47. Has sewers and electric lights.



Dam on Acushnet River, New Bedford, Mass.

History.—Built in '66-9 by city when pop. was about 23,000. Chf. Engr., Geo. A. Briggs. Consult. Engr., Wm. J. McAlpine, deceased.

Water Supply.—Acushnet river and Little Quittacus pond, by gravity from storage reservoir to city, thence by pumping to distributing reservoir and standpipe. Storage reservoir formed by dam across river, about 7 miles north from center of city; river above has watershed of 5 sq. m.

Pond was connected with storage reservoir in '86 by cutting canal between the two. Area of pond, 320 acres; drainage area, 1,125 acres; 10 ft. storage reservoir, 2½ miles from its northern boundary and 11 miles from city. Pond is one of chain known as Lakeville ponds, which together have an est. drainage area of 55 sq. m. and constitute largest body of fresh water in State.

Dam and Storage Reservoir.—Cap., 400,000,000 galls.; area, normal water surface, 300 acres. Elevations above high tide: top of dam, 44 ft.; high-water, 40 ft.; bottom of conduit, 23 ft.; bottom of gate-house, 26.2 ft. Dam in of town Acushnet, at locality known as Long Plain, 7 miles from City Hall; built in middle of heavily wooded swamp, with east bank of valley 30 ft., and west, 50 ft. above swamp-level. Banks were of coarse and fine gravel and sand, somewhat porous, but when removed, carefully selected and placed in embankment were perfectly water tight.

Material beneath site of dam was muck, 2 to 6 ft., and in one place, 12 ft. deep. Below muck was 1 to 3 ft. of hardpan, overlying 20 to 30 ft. of compressed sand resting on irregular rock surface. At west end of dam hardpan disappeared and sand rose into bank 12 ft. above its level in swamp. Muck under upper slope of dam, and at points under lower slope was removed to hardpan.

Dam: earth, with heart-wall; 650 ft. long, 20 ft. wide on top. Upper half of dam of fine gravel, coarse sand, loamy sand, selected from banks near by and carted on in 6-in. layers. *Heart-wall:* puddle, of same material as described above, moistened and mixed with spade; 12 ft. through at widest place, stepped as shown in section, bottom carried to and generally 2 to 6 ft. below hardpan. Ends extend into natural banks.

Spillway and Overfall: east of dam, 75 ft. from end; 50 ft. wide, on concrete foundation 1 ft. or more thick; paved with 1 ft. of rubble granite, except overfall, which is hammer-dressed. Channel begins 150 ft. above dam, and is carried 750 ft. below, last 500 ft. being through swamp to river. Entirely free. Formerly rested on timber and plank foundation, which was nearly washed away during the great freshet of Feb. 14-16, '86. *Gate-house:* at west end of dam, hammer-dressed stone in hydraulic cement, on timber and plank foundation. *Discharge-pipe:* see Conduit, below. Extends through dam from gate-house. Water can be drawn down 9 to 10 ft. Formed on sand.

In '67, after filling reservoir, leaks began to appear, and in Feb., '68, gate-house and 100 ft. of the bank swept away. W. J. McAlpine reported that failure was due to fine sand beneath gate-house and culvert becoming saturated and running as quicksand. In rebuilding, this material was confined by two rows of sheet piling, 15 ft. apart. See References, below.

Built in '66. Des. Engr., Wm. J. McAlpine, deceased. Const. Engr., Geo. A. Briggs. Contr., Geo. W. Lobdell. Cost, $18,846; improvements, $45,557; total, $64,403.

Conduit—Dy. cap., 11,664,000 galls. Head, av., 8⅞ ft. Single ring, brick, oviform, 3 by 4 ft., having 3-ft., semicircular bottom, and extending 5¾ miles with grade of 0.58 ft. per mile, and with 3 overflows.

Receiving Reservoir.—Cap., 3,000,000 galls; 12 ft. deep; has banks 15 ft. wide on top, slopes 2 to 1 outside, and 1½ to 1 inside. Inner slope lined with puddle 4 ft. wide at top and 10 ft. wide at bottom, carried 3 ft. below bottom, and protected with lining of 1-ft. granite stones, having joints well filled with gravel. Elevation, 30 ft. above tide.

Conduit to pump-wells: c. i., 42 in., 270 ft. long. A 36-in. c. i. pipe extends from main conduit around receiving reservoir to pump-wells, for use in emergency. Until '85, stone culvert connected reservoir and pump-well.

Pump-Well.—Three. First well, 12 x 31 ft., by 17 ft. deep, with 4 5 x 6-ft. recesses for pumps. Two wells have been added shaped like figure 8: portion within building, 7 ft., without, 10 ft. in diam.; depth not given.

Pumping Machinery.—Combined dy. cap., 15,000,000 galls; one 6,000,000 McAlpine, built by Quintard Iron Works, N. Y. City, one 4,000,000 and one 5,000,000 Worthington.

Force Main.—Length, 2,200 ft.; diam., not given; originally 16 ins.

Distributing Reservoir.—Cap., 15,000,000 galls.; 124 ft. above pump-well, and 154 ft. above tide-level. Depth, 17 ft.; embankments from 8 to 18 ft. above natural surface of ground, with tops 15 ft. wide and slopes of 2 to 1. Inner slope lined with puddle, 7 ft. wide at top and 15 ft. wide at bottom of reservoir, and carried 5 ft. below. This puddle is covered with 12 ins. of gravel, on which is laid granite wall 18 ins. thick at bottom and 12 ins. at top; joints grouted with Rosendale cement.

Stand-Pipe.—Is 5 x 43 ft.; for use in emergency.

Distribution.—*Mains*, 30 to 4 in. c. i., w. i. and cem., 59.2 miles. *Services*, c. i., lead. *Taps*, 5,785. *Meters*, Crown, Equitable, Balls & Fittz rotary, 108. *Hydrants*, Chapman, Coffin, for past 10 years, 445. *Valves*, kind, do. *Close of '70*: Mains, 17.45 miles. Taps, 533. Meters, none. Hydrants, 127. *Close of '80*: Mains, 42.27 miles. Taps, 3,798. Meters, 22. Hydrants, 295.

Consumption, 3,319,707 galls. *Pressure*, 33 lbs.

Financial—Cost, 1,355,321. Debt, $780,000: $140,000 at 7, $420,000 at 6, $100,000 at 5, $120,000 at 4%; $100,000 of the 6% debt is trust funds, remainder of debt, bonds. Sinking fund, $1,220. Int., av., 5.81%. Ann. op. exp., $31,249. Ann. int., $46,300. Ann. rev.: consumers, $49,536; city, $12,000, general appropriation for water. Hydrant rental, none. First cost, $526,000; close of '70, $641,774; close of '80, $1,013,325. Rev. in '70, $6,900; in '80, $41,026.

Management.—Water Board. Prest., Walter Clifford. Registrar and City Treas., Jas. H. Hathaway. Clerk Water Board and Supt., R. C. P. Coggeshall.

References —For further details regarding pumps, see Tenth Census U. S., Vol. XVII., Water Supply of Cities, p. 260.

Regarding break in dam, see "An Account of the Method Adopted to Repair Breach in the Earthen Dam of the Storing Reservoir of the New Bedford Water-Works" By Wm. J. McAlpine. Trans. Am. Soc. C. E., Vol. I., pp. 57-73

NEWBURYPORT, *Essex Co.* (Pop., 15,538; est., 14,000.) On Merrimack river, a port of entry; large commercial interests; manufactures brushes, hats, shoes, silverware and cotton goods. No sewers. Has electric lights.

History.—Built in '81 by Newburyport Water Co. Engr. and Contr., Geo. H. Norman, Newport, R. I.

Water Supply.—Wells, pumping to tank. One well 20 ft. in diam., 18 ft. deep; second, size not given, but smaller.

Pumping Machinery.—Dy. cap., 4,000,000 galls., two pumps upright, comp., double acting; from A. Russell & Sons, Newburyport.

Tank.—Cap., 300,000 galls.; 40 x 35 ft.; top 155 ft. above tide-level.

Distribution.—*Mains*, c. i., w. i. and cem., 26 miles. *Services*, w. i. and cem. *Taps*, 1,450. *Meters*, 20. *Hydrants*, Chapman, Holyoke, 168.

Consumption, 400,000 galls. *Pressure*, 55 lbs.

Financial.—Cost withheld, est, $480,000. Cap. stock, $300,000. Debt, not given. Ann. op. exp. withheld, est., $7,000 Ann. rev.: consumers, withheld, est., $32,000; city about $6,500. Hydrant rental, $40.

Management.—Prest., H. B. Little. Treas., Geo. H. Norman, Newport, R. I. Secy. and Supt., J. E. McCusker.

NEWTON, *Middlesex Co.* (Pop., 16,995; est., 22,500.) On Charles river, about 7 miles from Boston. Engaged in paper and other manufacturing. Incorp. No sewers. Has electric lights.

History.—Built in '76 by city. Des. Engrs., Moses Lowe and Frederick Schaff. Const. Engr., Edw. Sawyer. High-service system has been projected for '90.

Water Supply.—Charles river, by pumping to reservoir from filter basin.

Filter Basin.—Across river from Newton, following river in shape of bow. In gravel, 1,575 ft. long, and from 70 to 88 ft. wide, with 10-ft embankments along its sides for protection. In '80, under advice of Wm. E. Worthen, several pipes were driven through sand bottom of filter basin to coarse gravel, 35 ft. below, resulting in dy. yield of 400,000 galls. of water. In '88 a 48-in. conduit, or gallery, covered, was extended from the basin, southerly, 2,000 ft. along river.

Suction Pipe.—A 24-in. pipe crosses river, and connects filter basin with pump-well.

Pump-Well.—Brick walls with bottom of Georgia pine, 9.83 x 29.75 ft., x 15 ft. deep.

Pumping Machinery.—Dy. cap., 6,000,000 galls.; two Worthington; one 1,000,000 dup., high-pressure, with 12-in. water plungers and 15-in. stroke, and one 5,000,000 comp., dup., with 22-in. water plungers and 50-in. stroke. *Boiler:* horizontal; made by Kendall & Roberts, Cambridgeport, Mass.

Force Main.—Diam., 20 ins.; length, 21,120 ft; head on pumps, 201¾.

Reservoir.—Cap., 15,000,000 galls.; storage and regulating; pentagonal, in two divisions, in excavation and embankment on Waban hill with water surface 265 ft. above low tide. Has 2-ft. puddle lining over slopes of banks, under banks and on reservoir bottom. Slopes are covered with 6 ins. of small stones and 15-in. stone pavement above. *Heart-wall:* puddle, dimensions not given.

Distribution.—*Mains*, c. i., 90 miles. *Services*, lead, cham. i. *Taps*, 4,050. *Meters*, 2,500; principally Crown, with some Worthington and Union and a few Desper and Spooner. *Hydrants*, Whittier. *Valves*, Chapman.

Consumption, 710,000 galls. *Pressure*, 70 lbs.

Financial.—Cost, about $120,000. Debt (in '88,) $1,115,000. Sinking fund, $250,000 Int., 4 and 6%. Ann. op. exp., $14,000, Ann. rev.: consumers, $50,000; city, $15,000; Hydrant rental, $20.

Management.—Five Comrs. Prest., Edw. W. Cate. Registrar and Clerk, Albert S. Glover. Engr. of Board, Albert F. Noyes. Supt., H. Nelson Hyde, Jr.

NORTH ADAMS, *Berkshire Co.* (Pop., 10,191; est. 15,000. On Hoosac river, in hilly country. Manufactures cotton and woolen goods and shoes. No sewers. Has electric lights,

History.—Built in '65 by fire district. Const. Engr., Frank B. Locke, Salmon City, Ida.

Water Supply.—Brook and two artesian wells, by gravity from brook and by pumping from wells, latter yielding 800,000 galls. daily.

Reservoirs.—Cap., 10,850,000 galls.; three, collecting, settling and distributing, 100,000, 10,000,000 and 750,000 galls. respectively; last is 250 ft. above town.

Pumping Machinery.—Dy. cap., 2,400,000 galls.; Knowles.

Distribution.—*Mains*, 16 to 4-in., c. i. 44 miles. *Services*, w. i. *Taps*, 1,850. *Meters*, 7. *Hydrants*, kind not given, 132.

Consumption, 1,200,000 galls. *Pressure*, 87 lbs.

Financial.—Cost, withheld, est., $300,000. Debt, $200,000. Int., 4%. Ann. op. exp., withheld, est., $7,000. Ann. rev.: total, $22,500. Hydrant rental, none.

Management.—Prudential Com. Chn., A. W. Preston. Secy. and Treas., F. S. Richardson. Supt., Jno. J. Marsh.

NORTHAMPTON, *Hampshire Co.* (Pop., 12,772; est., 14,000.) On Connecticut river, main portion being on elevated ground one mile from river. Engaged in manufacturing. Incorp. city in '84. Has electric lights.

History.—Built in '71 by city. Supplies villages of Florence and Leeds, which are on pipe line. Engrs., Nelson J. Welton and Wm. W. Bonnett, Waterbury, Conn.

Water Supply.—Roberts' Meadow brook, by gravity from impounding reservoirs. Brook flows through rough granite region; drainage area, 9.24 sq. m.

Reservoirs.—Cap., 20,500,000 galls.; one 4,000,000, and one 16,500,000 galls.

Dam.—At first reservoir: earth, 17 ft. high at center with heart-wall of puddle 12 ft. wide at bottom and 6 ft. at top, with upper slope of 2 to 1 paved with stone. Flow-line is 244 ft. above town.

Gate-Chamber.—Brick, from which a 24-in. waste and 16-in. supply pipe pass through dam.

Supply Main.—Cap., 2,350,000 galls.; head, 244 ft.; 2½ miles of 16, 2½ miles of 12-in., c. i.

Distribution.—*Mains*, c. i, 35 miles. *Services*, c. i., enam i., galv. i. *Taps*, 1,800. *Meters*, 10. *Hydrants*, Mathews, Holyoke, 184. *Gates*, Ludlow, Chapman. *At close of* '80: Mains, 21 miles. Hydrants, 125.

Consumption, est., 650,000 galls. *Pressure*, 85 lbs.

Financial.—Cost, $267,565. Debt, $165,000: $100,000 at 6, $50,000 at 4, $15,000 at 3½%. Sinking fund not given, but there is one. Ann. op exp., $2,227. Ann. rev.: consumers, $22,365; city, $4,000, for all public uses, or about $21 per hydrant. First cost, $173,117; to close of '80, $209,000. Rev. from consumers, '72, $4,865; '80, $13,702.

Management.—Six Comrs. Prest., D. W. Bond. Treas., O. Edwards. Clerk, H. A. Kimball. Supt., J. M. Clark.

NORTH ATTLEBOROUGH, *Bristol Co.* (Pop., est., 7,000.) No sewers. Has electric lights.

History.—Built in '84 by fire district. Engr., Percy M. Blake, Hyde Park.

Water Supply.—Well, 26 ft. in diam., 30 ft. deep, pumping to stand-pipe. Contrs. for well, Collins & Morley, Boston.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Davidson comp., cond.

Stand-Pipe.—Cap., 564,000 galls.; 40 x 60 ft.; from Cunningham Iron Works, Boston.

Distribution.—*Mains*, 12 to 6-in., c. i., 11.2 miles. *Services*, enam. i. *Taps* (in 87), 471. *Meters*, Crown, Union rotary, Hersey, 201. *Hydrants*, Mathews, Ludlow, 101. *Valves*, Pect.

Consumption, 3,553 galls. *Pressure*, 82 lbs.

Financial.—Cost to Mar. 1, '89, $140,968. Bonded debt, $125,000. Int., 4%. Sinking fund, $17,408. Ann op. exp., $3,456. Ann. rev.: total, $5,295.

Management.—Comrs. Chn., O. B. Weston, Clerk, Supt. and Eng., Walter T. Whittemore.

NORTHBOROUGH, *Worcester Co.* (Pop., 1,676; est., 2,000.) On Assabet river, on nearly level ground, surrounded by hills. Engaged in manufacturing shell jewelry and woolen cloth. Incorp. No sewers or electric lights.

History.—Built in '82 by town. Engr., Percy M. Blake. Contrs., Goodhue & Birnie, Springfield.

Water Supply.—West branch of Cold Harbor brook, by gravity from impounding reservoir. Brook is 3 miles from, and 180 ft. above, village.

Impounding Dam and Reservoir.—Cap., 30,000,000 galls.; area, 9 acres; drainage area, 2¼ sq. m. Dam of earth, 650 ft. long, 20 ft. high, with heart-wall of rubble masonry laid in cem.

Distribution.—*Mains*, w. i. and cem., 9 miles. *Services*, cnam. i. *Taps*, 218. *Meters*, none. *Hydrants*, Chapman, 51.

Consumption, est., 70,000 galls. *Pressure*, 60 lbs.

Financial.—Cost, $68,142. Debt, $61,500. Int., 4%. Sinking fund, Feb. 1, '89, $13,106. Ann. op. exp., $355. Ann. rev.: consumers (in '87), $3,439; city, none.

Management.—Three Comrs. Prest., G. P. Heath. Secy. and Treas., Sumner Small.

NORTHFIELD, *Franklin Co.* (Pop. of town, 1,603.)

History.—Built in '05 by Northfield Aqueduct Co,

Water Supply --Brook, by gravity.

Conduit.—Bored logs, 2-in., 1¼ miles long.

Distribution.—*Mains*, 1-in., material not given, 1¼ miles; total length of pipe, 2½ miles. Consumers, in '80, 12.

Financial.--Cost, not given, but est., $5,000. Ann. op. exp., nominal. Ann. rev.: not given, est., $150.

Management.--Address Co.

NORTH EASTON, *Bristol Co.* (Pop., est., 2,500.) In township of Easton. Incorp. No sewers or electric lights.

History.—Built in '87-8 by North Easton fire district. Engr., Percy M. Blake.

Water Supply —Collecting well, pumping to stand-pipe and direct. Well is near Queset river, 27.7 ft. deep, 26 ft. in diam. at bottom and 28½ ft. at top. First 4 ft. from bottom is lined with dry wall of large stone, and remaining distance with dry stone work, with interior 12-in. brick lining in cem., water tight.

Well has storage cap,, available for pumping, of about 100,000 galls.; is covered with conical roof, with provisions for ventilating. Contr., Jno. A. Gill, East Boston.

Pumping Station.—Brick, with slate roof. Chimney, 75 ft. high, with core 30 ins. in diam. Floor of engine-room is 150 ft. above high water in reservoir, and 28.7 ft. above bottom of suction pipe at well. Contr., Geo. Howard, Brockton.

Pumping Machinery.—Dy. cap., 1,200,000 galls.; two 600,000 Worthington comp., cond., dup., each with 9-in. high, and 16-in. low-pressure cylinders, and 8½-in. water plungers, all of 10-in. stroke. *Boilers:* two Whittier, each 4½ x 15 ft., with 22½ sq. ft. of grate surface.

Suction and Force Mains.—The former is 12, and the latter 10 ins. in diam.

Stand Pipe.—Cap., 235,000 galls.; 20 x 103 ft.; high water level, 3 ft. from top.

A 10-in. pipe, 90 ft. high, is placed in center of stand-pipe, connecting with force main. It is provided at base with automatic check-valve, set on branch pipe, which closes when pumps are working, and opens when water passes from reservoirs.

Top of pipe has wooden cover, and the whole is surmounted by ornamental top. Foundation built by day's labor, and is 7 ft. deep, of stone masonry in cem., with brick entering arch and interior well for supply and discharge pipe. Pipe secured to masonry by six 2-in. anchor bolts.

Distribution.—*Mains*, c. i., tarred, 6½ miles; from Gloucester Iron Works, Philadelphia, Pa., laid by Chas. H. Eglee, Flushing, N. Y. *Services*, cnam. i; connections made by O. N. Bingham, Dedham. *Taps*, 240 *Meters*, 9. *Hydrants*, Ludlow, 60. *Valves*, Ludlow.

Consumption, 87,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 180 lbs.

Financial.—Cost, $78,000. Debt, $75,000. Int., 4%. Ann. op. exp., $1,300. Ann. rev.: consumers, $4,260; city, none at time of report.

Management.—Comrs.: Oliver Ames, Fred'k. L. Ames and Cyrus Lathrop. Clerk, Geo. K. Davis.

NORTH GRAFTON, *Worcester Co.* See Grafton.

NORWOOD, *Norfolk Co.* (Pop., 2,315; est., 4,000.) Manufacturing town, 15 miles from Boston. Not incorp. No sewers or electric lights.

History.—Built in '85-6 by town. Engr., Percy M. Blake, Hyde Park. Contr., Jno. T. Longford, Boston.

Water Supply.—Pond, pumping to reservoir. Pond fed by springs; has cap. of 123,000,000 galls.; area of 250 acres.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two 1,000,000 Davidson; one added in '89.

Reservoir.—Cap., 1,400,000 galls.; 126.8x145¼ ft., at high-water; 84.8x104½ ft. at bottom, and 14 ft. deep. Bottom covered with concrete. Contrs., Mitchell & Harris, Boston.

Distribution.—*Mains*, c. i., 12½ miles. *Services*, w. i. Pipes from Warren Foundry & Machine Co., Phillipsburgh, N. J.; laid by Jno. T. Langford, Newton. *Taps*, 400. *Meters*, 86. *Hydrants*, Chapman, 85. *Valves*, Chapman.

Consumption, 300,000 galls. *Pressure*, 50 lbs.

Financial.—Cost, $110,000. Debt, $100,000. Int., 4%. Ann. op. exp., $3,000. Ann. int., $4,000. Sinking fund, $10,000. Ann. rev.: consumers, 5,700. Hydrant rental, free.

Management.—Three Comrs. Supt. Geo. A. P. Bucknam.

ORANGE, *Franklin Co.* (Pop., of township, 3,169; est., 3,650). Manufactures sewing machines, furniture and water-wheels. Has electric lights.

History.—Built in '75, by New Home Sewing Machine Co.

Water Supply.—Spring, by gravity from reservoirs, with pumping from Miller's river in dry weather.

Reservoirs.—First has area of ¼ acre, and depth of 8 ft. From this water passes to reservoir 30 ft. sq., x 12 ft. deep.

Distribution.—*Mains*, w. i. and cem., length not given. *Services*, w. i., lead. *Taps*, not given, but about 100 families are supplied.

NOTE.—Inquiries in '89 were all ignored.

PALMER, *Hampden Co.* (Pop. supplied, est., 2,000.) On Chicopee river. Manufactures carriages, straw hats and cotton goods. Not incorp. No sewers. Has electric lights.

History.—Built in '86 by Palmer Water Co. Engr., C. L. Goodhue, Springfield. Contrs., Goodhue & Birnie, Springfield.

Water Supply.—Numerous springs, by gravity from storage to distributing reservoir, thence by gravity to village.

Reservoirs.—Combined cap., 8,000,000 galls. *Storage:* cap., 6,000,000 galls.; area, 5 acres. *Distributing:* cap., 2,000,000 galls.; area, 1 acre.

Distribution.—*Mains*, 10 to 4-in. w. i. and cem., 5 miles. *Services*, lead. *Taps*, 200. *Meters*, none. *Hydrants*, Chapman, 40. *Valves*, Chapman.

Consumption, 70,000 galls. *Pressure*, 70 lbs.

Financial.—Cost, $40,000. Debt, $20,000. Int., 5%. Ann. op. exp., $1,200. Ann. int., $1,000. Ann. rev.; consumers, $3,200; city, $800. Hydrant rental, $20.

Management.—Prest., C. L. Goodhue, Springfield. Secy., C. K. Gamwell. Treas. and Supt., Jno. H. Gamwell.

PEABODY, *Essex Co.* (Pop. 9,028; est., 10,000.) About 2 miles from Boston, on irregular ground rising from tide-water to elevation of 160 ft. Engaged in tanning and morocco manufacturing. No sewers or electric lights.

History.—First supplied in 1799 by Salem & Danvers Aqueduct Co., which had capital of $10,000. Supply was by gravity from springs collected in reservoir, through 3-in. bored pine logs, which were changed to 5-in. in '01 and to iron pipes in '34. In '59 Co. had expended $246,200, had laid 40 miles of pipe and had 3,400 takers. Separate works were built by Salem in '68, by Danvers in '76, while in '73 Peabody bought old system for $125,000, which then consisted of Spring pond, with area of 50 acres at 60 ft. above tide-level, Brown's pond, and two stone reservoirs, 100 x 300 ft. and 5 ft. deep.

In '81-2 high service works were built by town. Contr., Geo. F. Norman, Newport, R. I.

Water Supply.—Spring and Brown's ponds, by gravity and by pumping to tank. Overflow of ponds passes into two small reservoirs. Drainage area, 550 acres.

Reservoirs.—Not described.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; Worthington.

Tank.—Cap., 524,000 galls.; 60 x 25 ft.; from Cunningham Iron Works, Boston.

Distribution.—*Mains*, c. i., w. i. and cem., 25½ miles. *Services*, w. i. and cem. *Taps*, 1,510. *Meters*, 1. *Hydrants*, Post, 176.

Consumption, 688,346. *Pressure*, 65 lbs.

Financial.—Cost, $292,552. Debt, $223,000. Int., 4%. Sinking fund, $12,384. Ann. op. exp., $6,000. Ann. int., $11,407. Ann. rev.: consumers, $23,055.

Management.—Water Board. Chairman, D. S. Littlefield. Clerk, Jas. Rodie. Supt., N. M. Quint.

PITTSFIELD, *Berkshire Co.* (Pop. 13,361; est., 15,000.) In elevated valley. Engaged in manufacturing and general trade. Incorp. town in 1761. Has sewers and electric lights.

History.—Built in '55 by fire district. Engr., Phineas Ball, Worcester.

Water Supply.—Ashley Lake and Ashley and Sackett brooks, by gravity to two distributing reservoirs. Cap. of lake, 500,000,000 galls.; area, about 80 acres; drainage area, about 300 acres.

Dams.—*Ashley lake:* stone, cemented, on rock foundation; 20 ft. long, 10½ ft. high, 8 ft. wide at bottom and 4 at top. Outer face is straight. *Spillway:* 8 ft. wide by 10 ins. high. *Discharge-pipe:* 20-in. Lake rises very slowly. Water flows from lake down natural stream to distributing reservoir. Cost, see below. *Dam at Distributing Reservoirs:* rough stone, faced with chestnut plank; 40 ft. long, 8 ft. thick.

Distributing Reservoirs.—Cap., 400,000 galls.; earth and stone; elevation above town, one, 128, other, 140 ft.

Supply Mains.—*Old:* c. i., 12-in. for 3, 10-in. for 2 miles. *New:* 16-in.; added in '89.

Distribution.—*Mains*, c. i., 36 miles; originally w. i. and cem. *Services*, all kinds, each party putting in its own. *Taps*, 2,300. *Meters*, 8. *Hydrants*, Mathews, 85. *Valves*, Ludlow.

Consumption, 2,000,000 galls. *Pressure*, 45 lbs. and upwards.

Financial.—Cost, $242,504. Debt, $195,000 : $90,000 at 6, $10,000 at 4½, $95,000 at 4%. Sinking fund, none. Ann. op. exp., $3,000. Ann. rev.: consumers, $21,458: city, $2,580. Hydrant rental, $30. Cost to close of '60, $5,500; '70, $153,000; '80 $193,835. Rev., for '60, $2,590; '70, $8,202; '80, $16,668.

Management.—Comrs., Chn.. W. R. Plunkett. Supt., Jno. M. Hatch.

PLYMOUTH, *Plymouth Co.* (Pop., 7,093; est., 7,500.) On Plymouth harbor in Massachusetts bay, on uneven land with sand and gravel soil. No sewers. Has electric lights.

OLD WORKS.

General Description.—Built in 1796 by Joshua Thomas and associates, under act passed by General Court of Mass. Supply, by gravity, from Deep Water Bridge, through 2 to 4-in pitch pine logs. Water supplied for domestic and fire purposes until '54, when town purchased plant, and in '54 laid w. i. and cem. pipe, abandoning old logs.

PRESENT WORKS.

History.—Built in '55 by town. Engr., Moses Bates. Consulting Engr., Wm. S. Whitiwell.

Water Supply.—Natural ponds, by gravity and direct pumping. Ponds are naturally connected, without dams. Names and areas in acres: Great, 275; Little South, 125; Boot, 40; Sont, 60.

Conduit.—W. i. and cem., 7,360 ft. long; 60 ft. of 20, 7,300 ft. of 10-in. Cap., 650,000 galls.; head, av., 16 ft.

Reservoirs.—Combined cap., 2,970,000 galls. *Low Service:* cap., 1,600,000 galls.; earth, in excavation and embankment, 116 x 200 ft., x 16 ft. deep; slopes, 1½ to 1; bottom and sides covered with 1½ ft. of puddle, 2 ft. of gravel, then paved with stone. Elevation, 105 above tide-level. Built in '55. Does not leak. *High Service:* cap., 1,370,000 galls.; in excavation, lined with 5 ins. of concrete, and ¾-in. of cem. mortar. Concrete has 1 part cem., 2 sharp sand, 6 gravel; mortar, cem. and sand, 1 to 1. Elevation, 165 ft. above tide. Built in '87. Does not leak.

Pumping Machinery.—Dy. cap., 1,440,000 galls.; Worthington comp., dup.; 14-in. plungers, 18-in. stroke, 42 to minute, 20-in. pump-barrel. Built in '79.

Force Main.—Originally 9,200 ft. of 10-in. w. i. and cem.

Distribution.—*Mains*, 16 to 2-in. w i. and cem., 28.2 miles. Partially laid by Ferris & Halladay, Jersey City. *Services*, w. i. and cem., lead, galv. i. *Taps*, 1,364. *Meters*, 1. *Hydrants*, Chapman, 79. *Valves*, Chapman.

Consumption, about 700,000 galls. *Pressure:* Ordinary, 36 lbs. Fire, 45 lbs.

Financial.—Cost, $24,822. Debt, $139,700: $20,000 at 6, $6,000 at 5, $6,000 at 4½, $107,700 at 4%. Sinking fund, $9,000. Ann. op. exp., $5,532. Ann. int., $6,130. Ann. rev.: consumers, $15,845; misc., $252. Rev. for '80, $10,570.

Management.—Five Comrs. Supt., R. W. Bagnell.

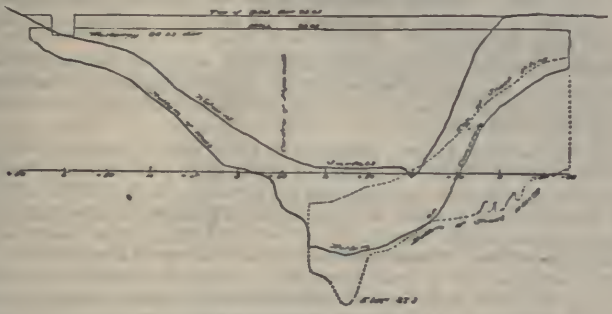
QUINCY, *Norfolk Co.* (Pop. 10,570; est., 13,000.) On Massachusetts bay, surrounded by high granite hills. Engaged in quarrying granite and manufacturing shoes. Settled in 1640; incorp. town in 1792. No sewers. Has electric lights.

History.—Built by Quincy Water Co. in '81. Engrs., A. H. Howland, Boston, and Phineas Ball, Worcester.

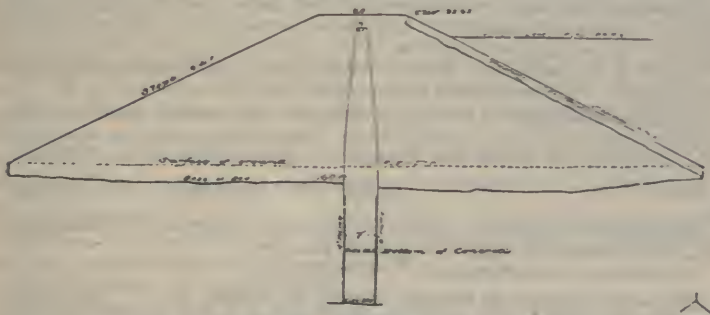
Water Supply.—Two wells in gravel bed and storage reservoir on Town brook, pumping to stand-pipe. One well is 30 ft. in diam., 28 ft. deep, and the other 132 ft. in diam., 22 ft. deep. Supply from Town brook was originally drawn through filter bed described below.

Old Filter Bed.—Screened gravel, in which are 15 rows of 6-in. drain pipe, 250 ft. long, with lap of each joint cemented and bottom open. Pipes have 10 ins. of gravel about them, surface-level of which is 42 ins. below water-level of brook. Discharge into well is controlled by gates. [Probably not now in use.]

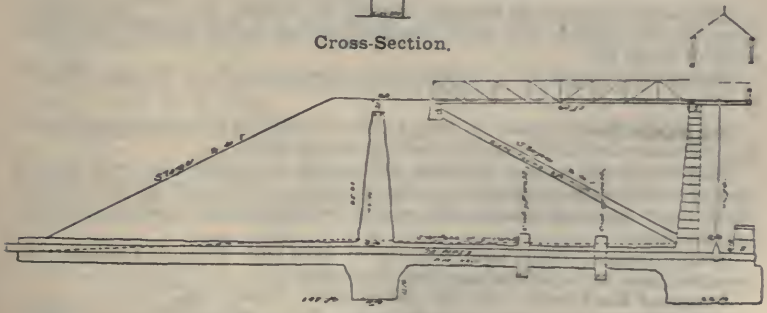
Town Brook Dam and Reservoir.—Cap., 189,000,000 galls.; area flooded, 47 acres; drainage area, 1,000 acres of sparsely settled land, little tilled. Dam 1¼ miles above pumping station on same stream, and 600 ft. below junction of two valleys;



Longitudinal Section.



Cross-Section.



Section Through Gate-Chamber.

Town Brook Dam, Quincy, Mass.

one-half natural basin was clayey soil thickly covered with granite boulders, the other, sand and gravel; the whole covered with brush, trees and stumps. Brush and trees were cut, and these, with some of the stumps and roots, were removed. Natural surface beneath dam was removed to from 2 to 12 ft. to secure good foundation. *Dam:* earth, with masonry heart-wall; length, 550 ft.; greatest height above natural surface, 34.83 ft.; greatest thickness, 160 ft. wide at bottom, 20 at top. Water 30 ft. deep at dam, surface being about 5 ft. below top of dam. Slopes, 2 to 1, lower one and top covered with 1 ft. of loam, and upper with 2 ft. of paving. Bank built up in 6-in. layers, rolled or rammed.

Heart-wall: partly masonry and partly concrete; founded on concrete and sheet-piling part of its length; about 7 ft. thick at bottom and 2½ at top, which is 3 ft. below top of dam. Owing to sudden dip in hard bottom below one end of dam, two rows of sheet-piling were driven beneath heart-wall, 7 ft. apart, for 193 ft., and upper row continued up stream at angle of 34° 15′ for 117 ft. Upper row, 6-in., lower, 4-in. hard pine, grooved and splined. Length of piling, 15 to 26 ft. Single row was driven in trench from 4 to 19 ft. deep, and, after driving double row, sand between was excavated from 15 to 20 ft. deep. These trenches were filled with concrete. About ⅔ of upper 15 ft. of wall was of concrete, to save stone for paving. Concrete, 1 part Hoffman cement, 2 of sand, 5 of gravel.

Spillway: in natural ground at end of dam; 25 ft. wide, 5 ft. deep, with side-walls of ashlar masonry, 4 ft. thick at bottom and 2 at top. From 26 ft. above to 66 ft. below heart-wall bottom is of stone masonry, 2½ ft. thick; remaining 153 ft. of bottom, paved with 3 ft. of dry stone.

Gate-house: masonry, 8 ft. sq., with opening 2½ ft. wide on reservoir side, extending from top to within 8.15 ft. of bottom of pipes, fitted with movable wire screens and stop-planks, and permits drawing from any elevation. Walls 5 ft. thick at bottom, 3 at top. Foundation of masonry 22 ft. sq., carried 9 ft. below bottom of pipes.

Discharge-pipes: a 20-in. supply, 20-in. waste and 6-in. drain. Large pipes 2 ft. apart, small one between. Supply and drain-pipes terminate in gate-chamber; waste-pipe extends into reservoir, to drain lowest part. Supply-pipe reduced to 12 ins. below dam, and provided with 12-in. branch and gate above reduction to serve as waste-pipe. Cap. of pipes equal to full flow of stream during heavy rains. Pipes inclosed in masonry wall extending fully 2½ ft. below bottom, and 1 ft. at each side and top. At intersection with heart-wall latter is 10 ft. thick, and extends 10 ft. below bottom of pipe-wall. Two cut-off walls extend 2½ ft. below bottom of pipe-wall, and 4 to 5 ft. on each side. See accompanying sections.

Built in '87-8. Engr., L. A. Taylor, Boston; Asst., C. H. Truesdale. Contrs. and cost not given. For more detailed description see *Eng. News*, Vol. xxi., p. 565.

Pumping Machinery.—Dy cap., 4,000,000 galls.; two 2,000,000 Deane; one Deane a high-pressure dup. of 24-in. steam, and 14-in. water cylinder and 18-in. stroke; other comp., cond., dup., of 16- and 30-in. steam, and 44-in. water cylinder, and 24-in. stroke.

Stand-Pipe.—Cap., 318,000 galls.; 30x60 ft.; from Cunningham Iron Works, Boston.

Distribution.—*Mains*, c. i., kal. w. i., 30 miles. *Services*, w. i., lead, galv. i. *Taps*, 1,000. *Meters*, 45. *Hydrants*, kind not given, 98.

Consumption, about 260,000 galls. *Pressure*, 80 lbs.

Financial.—Cost (in '88), $275,000. Debt (in '88), $125,000. Int., 5%. Ann. op. exp., withheld, est., $2,000. Ann. rev.: consumers, withheld, est., $24,000; city, $3,650. Hydrant rental, $35.

Management.—Prest., J. A. Gordon. Secy. and Treas., W. L. Faxon. Supt., F. E. Hall.

RANDOLPH, *Norfolk Co.* (Pop., 4,027; est., 5,000.) Is 15 miles south of Boston. Manufactures boots and shoes. No sewers or electric lights.

History.—Built in '87-8 by towns of Randolph and Holbrook, towns owning jointly pumping station, stand-pipes and mains between. Engr., M. M. Tidd, Boston. Contr., Jno. T. Langford, Boston. Sub.-contrs. for buildings and masonry, H. Pike & Son, Cambridge.

Water Supply. Great pond, pumping to stand-pipe. Pond in Randolph and Braintree; area, 130 acres; drainage area, 2,200 acres.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Gaskill dup.

Stand-Pipes.—Cap., about 1,000,000 galls. Two. One not described. Other: cap., 650,000 galls.; 30 x 125 ft.; from Cunningham Iron Works, Boston.

Distribution.—*Mains*, c. i., 10 miles. *Services*, w. i. and cem. Pipe and specials from Warren Foundry & Machine Co., Phillipsburg, N. J.; pipe laid by J. T. Langford, Boston. *Taps*, 310. *Meters*, none. *Hydrants*, Chapman, 103. *Valves*, Chapman.

Consumption, 210,000 galls. *Pressure*, 80 lbs.

Financial.—Cost, $120,000. Bonded debt, $120,000. Int., 4%. Sinking fund, $7,150. Ann. op. exp., joint works, $4,000. Ann. rev.: consumers, $3,282; city, $2,000. Hydrant rental, about $20.

Management.—Jointly by the two towns of Randolph and Holbrook. Chn. Randolph Comrs., J. White Belcher, Randolph. Secy., Peter B. Hand. Supt., E. J. Chadbourne.

REVERE and WINTHROP, *Suffolk Co.* (Pop., Revere, 2,263; est., 4,000. Winthrop, 1943; est., 1,509.) Suburbs of Boston. Revere incorp. town; has sewers and electric lights.

History.—Built in '84 by Revere Water Co.

Water Supply.—Driven and collecting wells, by pumping to reservoir. Two collecting wells; one 20, one 30 ft. in diam., both 20 ft. deep.

Reservoir.—Cap., 1,500,000 galls.; 194 x 236 ft., x 20 ft. deep.

Pumping Machinery.—Dy. cap. 2,500,000 galls.; Knowles and Deane. 1,250,000 galls. each.

Distribution.—*Mains*, w. i. and cem., 32 miles. *Services*, w. i. and cem. *Taps*, 1,530. *Meters*, none. *Hydrants*, Chapman, Ludlow, Holyoke, 118. *Valves*, kind, do. *Consumption*, about 350,000 galls. *Pressure*. 75 lbs.

Financial.—Cost, $300,000. Bonded debt (first of '89), $200,000. Int., not given. Ann op. exp., $4,000. Ann. rev., total, $23,907. Hydrant rental, $50 for first lot, $40 for additional.

Management.—Prest., Wm. Birnie. Treas., T. N. Birnie. Supt and Secy., Albert S. Burnham.

RICHMOND FURNACE, *Berkshire Co.* (Pop., est., 400.) On both sides Center brook, on irregular ground.

History.—Built in '82 by Richmond Iron Works to supply their shops and houses. Engr., Wm. E. Pettee.

Water Supply.—Center brook, by gravity.

Filter.—Charcoal, at dam.

Dam and Reservoir.—Cap., not given; area flooded, ½ acre; 4,000 ft. from village. Dam of gravel with stone heart-wall and rock foundation; 80 ft. long, about 8 ft. high, with outer slope planked. *Spillway:* excavated, lined with plank, free; center about 20 ft. from east end; slope, about 1 to 1.

Discharge-Pipe.—12-in. Does not leak. Built in '83. Contr., Jno. Viola. Cost, $1,600.

Distribution.—*Mains*, c. i., 1½ miles. *Services*, galv. i. *Taps*, not given. *Hydrants*, 3.

Financial.—Cost, $4,000. Ann. op. exp., not given, est., $100. Ann. rev., not given, est., $500.

Management.—By above Co. H. J. Dresser.

RIVERSIDE, *Franklin Co.* (Pop., not given.) No sewers or electric lights.

History.—Date built not given. Owned by individuals until '89, when Riverside Water Co. organized under charter granted in '88.

Water Supply.—Springs, by gravity.

Distribution.—*Mains*, 3-in. c. i., 2,000 ft. *Taps*, 40. *Meters* and *Hydrants*, none.

Financial.—Cost, $5,000. No debt. Ann. op. exp., not given, est., $25. Ann. rev., $500.

Management.—Prest., T. M. Stoughton. Secy., C. R. Stoughton. Treas., H. A. Lamb. Supt., M. A. Ward.

ROCKLAND, *Plymouth Co.* (Pop., 4,553; est., 5,000.) Manufactures boots, shoes and tacks, Incorp. No sewers. Has electric lights.

History.—Built in '86 by town. Pumping machinery, stand-pipe and 6 miles of mains are owned jointly with adjoining town of Abington, and works were constructed and are managed by joint commission from two towns. Des. Engr., S. C. Heald, Worcester. Const. Engr., J. J. Walkenburg, Worcester. Consult. Engr., Phineas Ball, Worcester.

For details regarding water supply, pumping machinery, stand-pipe and contractors, see Abington.

Distribution.—*Mains*, c. i., 16 miles. *Services*, w. i. and cem. *Taps*, 750. *Meters*, '80. *Hydrants*, Coffin, 106. *Valves*, Coffin.

Consumption, 175,000 galls. *Pressure*. 75 lbs.

Financial.—Cost, $156,000. Bonded debt, $127,000. Int., 4%. Sinking fund, none. Ann. op. exp., $2,400. Ann. rev.: consumers, $6,000; city, $4,800. Hydrant rental, $20.

Management.—Comrs. Chn., G. W. Kelley. Secy. and Supt., Wm. R. Grose.

SALEM, *Essex Co.* (Pop., 27,563; est., 28,000.) On low land projecting into sea; has fine harbor. Incorp. Has sewers and electric lights.

OLD WORKS.

General Description.—The first supply was furnished by Dan'l Frye, in 1796, when the population was about 8,000, and was from a well on Gallows hill, through wooden pipes. In '07 five persons, styling themselves "The Proprietors of the Fyre

Aqueduct," took water from this well, and Co. continued till '52. Salem & Danvers Aqueduct Co. (see Peabody) built works in 1799, and extended and operated them until '73, when they were sold to Peabody.

PRESENT WORKS.

History.—Built by city '65-9. Des. Engr., Jas. Slade. Const. Engr., Chas. H. Swan. Consulting Engr., after Feb., '68, Jas. P. Kirkwood. Water was furnished to Beverly from '69 to '87.

Water Supply.—Wenham lake, by direct pumping, and pumping to reservoir. Lake is 4½ miles from city, 31 ft. above high tide; area, 320 acres; drainage area, 1,716 acres; av. depth of 53 ft.; fed by springs, has smooth, gravelly margin and a bottom free from mud, vegetation, or quartzose sand.

Intake Conduit and Gate Chamber.—C. i., 36-in., with bell, mouth turned up and grated: begins 32 ft. from shore, and conducts water 175 ft. to masonry gate chamber, 8 x 10 ft., x 13 ft. deep, from which brick conduit 7 x 10 ft. and 26 ft. long leads to pump-well. Gate chamber divided by masonry wall, with 4 gates at different levels, each 2 x 3 ft. Gates provided with double screens of ⅛-in. mesh copper wire.

Pump-Well.—Is 10 x 31¾ ft., inside of stone masonry, lined with 1 ft. of brick resting on timber and plank platform covered with 2 ft. of concrete.

Pumping Machinery.—Dy. cap., 10,000,000 galls.; two 5,000,000 Worthington.

Force Main.—C. i., 30-in., 5,600 ft. long; thickness varies from 1¼ ins. at pumps to ¾ in. at reservoir.

Reservoir.—Cap., 20,000,000 galls.; in excavation and embankment, 400 ft. sq., 20 ft. deep, with banks 15 ft. wide on top; inner and outer slopes, 1½ to 1; elevation of surface, 142 ft. above mean tide. Inner slopes covered with 1 ft. of gravel and 15-in. granite blocks, laid dry, except at inlet, where gravel is replaced by 9 ins. of concrete, and paving is laid in cement. Bottom covered with 2 to 4 ft. of puddle, connecting with heart-wall, above which is 1 ft. of gravel, then cobble stone paving, which around end of inlet pipe, for about 50 sq. ft. becomes cement masonry. *Heart-Walls:* puddle, 10 ft. thick for 12½ ft. from reservoir bottom, then 5 ft. *Discharge-Pipes:* three. Two 20, one 12-in. The 12-in. is a waste-pipe, and others lead from corners of south side of reservoir and join outside to form 20-in. supply main. The 20-in. pipes take water 2 ft. from bottom of reservoir, through boxes covered with copper wire screens of ⅛-in. mesh; all 3 pipes carried through banks on brick piers.

Distribution.—*Mains*, 30 to 4-in. c. i., w. i. and cem., 50 miles. *Services*, galv. i. *Taps*, 5,412. *Meters*, 137. *Hydrants*, Lowry, 378. *Valves*, Whittier. *Close of* '70: Mains, 35 miles. Taps, 2,476. Meters, none. Hydrants, 267. *Close of* '80, Mains, 44 miles. Taps, 4,456. Meters, 127. Hydrants, 345.

Consumption, 2,111,272 galls. *Pressure*, 40 lbs.

Financial.—Cost, $1,450,072. Debt, $623,500: $225,000 at 6, $398,000 at 5%. Sinking fund, $109,781; $21,000 raised annually. Ann. op. exp., $26,270. Ann rev.: consumers, $52,614; city, no allowance for hydrants. Cost to close of '70, $1,149,905; '80, $1,391,492. Rev., '70, $12,600; '80, $40,679.

Management.—Wenham Water Board. Prest., A. H. Smith. Clerk, Nath. M. Brown. Supt., Henry W. Rogers.

Reference.—Tenth Census U. S., Vol. XVII., Water Supply of Cities, pp. 100, 101.

SAUGUS, *Essex Co.* (Pop., 2,625; est., 3,000.) On Saugus river, near Lynn. Engaged in manufacturing shoes and woolen goods. Settled in 1629; incorp. town in '15.

History.—The village of East Saugus was supplied in '78 from Lynn and rest of town in '87. Town owns pipes. Const. Engrs., Chas. W. Gay, of Lynn, and Edw. A. Buss, Boston. Contrs., Goodhue & Birnie, Springfield, Mass.

Water Supply.—Lynn water-works, by connecting with same.

Distribution.—(In '87.) *Mains*, w. i. and cem., 9 miles. *Services*, w. i. and cem. *Taps*, 150. *Meters*, none. *Hydrants*, Chapman, 80. *Valves*, Chapman.

Consumption, not given. *Pressure*, 65 lbs.

Financial.—Cost (in '88), $45,800. Debt (in '88), $40,800. Int., 4%. Lynn collects water rates from Saugus and gives town rebate of 37½%. Saugus pays Lynn hydrant rental of $28 for each 350 inhabitants.

Management.—Comr., Wilbur F. Newhall, E. Saugus.

SHARON, *Norfolk Co.* (Pop., 1,492; est., 1,460.) Manufactures cutlery and carriages, and is summer resort for invalids. No sewers or electric lights.

History.—Built in '85 by Sharon Water Co. Des. Engr., Percy M. Blake, Hyde Park. Const. Engr., A. H. Howland, Boston. Contr., W. C. McClellan, Boston.

Water Supply.—Well, near Beaver brook, pumping to tank. Well is 16 ft. in diam. and depth, with walls of brick in cement.

Pumping Machinery.—Dy. cap., 720,000 galls.; Blake. *Boiler:* upright, tubular, from Cunningham Iron Works, Boston.

Stand-Pipe.—Cap., 208,000 galls.; 20x80 ft.; from Cunningham Iron Works, Boston.

Distribution.—*Mains*, c. i., c. i. and cem., 6.3 miles. *Services*, lead. Pipe laid by T. F. Maney & Co., Boston. *Taps*, 125. *Meters*, 8. *Hydrants*, Chapman, 21. *Valves*, Chapman.

Consumption, 50,000 galls. *Pressure*, 40 to 78 lbs

Financial.—Cost, $52,000. Cap. stock, $20,000. Bonded debt, $20,000. Int., 6%. Ann. op. exp., $13,000. Ann. rev.: consumers, $1,800; city, $1,200. Hydrant rental, $50.

Management.—Prest., E. W. Bond, Springfield. Treas., E. B. Stickney, Springfield. Secy. and Supt., W. B. Wicks.

SHELBURNE FALLS, *Franklin Co.* (Pop., 1,621.) Manfactures cutlery and hardware. Incorp. as fire district. No sewers or electric lights.

History.—Built in '84 by Coyell Aqueduct Co., for domestic supply. Const. Engr. G. G. Merrill.

Water Supply.—Mountain springs, by gravity.

Distribution.—*Mains*, w. i., 2.3 miles. *Services*, i., lead. *Taps*, '70. *Meters* and *Hydrants*, none.

Consumption, 9,000 galls. *Pressure*, 90 ft. head.

Financial.—Cost, $5,000. Debt, none. Ann. op. exp., $20. Taxes, $28. Ann. rev.: consumers, $423; city, $28.

Management.—Prest., G. G. Merrill. Secy. and Treas., Herbert Newell. Supt., L. T. Covell.

SOMERVILLE, *Middlesex Co.* (Pop., 24,933; est., 36,000.) On Mystic river, 2 miles from Boston. Has electric lights.

History.—Supplied in '68 from Mystic water-works, then owned by Charlestown, but now by Boston. City owns distribution, and does all work connected therewith, but Boston collects rates, and pays Somerville rebate of 50%. Des. Engr. for Somerville plant, Saml. Horne.

Water Supply.—Mystic system of Boston water-works, by tapping the 24 and 30-in. mains which pass through Somerville and on to Charlestown, Chelsea and East Boston.

Distribution.—*Mains*, w. i. and cem. previous to '84, and c. i. since. 54 miles. *Services*, galv. i. now used. *Taps*, 5,410. *Meters*, no record by Somerville, as these are put in by Boston. *Hydrants*, 375.

Consumption, no record by Somerville. *Pressure*, maximum, 55 lbs.

Financial.—Cost, $361,947. Bonded debt, $263,500. Int., 4 and 5%. Ann. op. exp., $15,570. Ann. rev., total, $47,431.

Management.—Supt., Nathl. Dennett. City Engr., Horace L. Eaton.

SOUTHBRIDGE, *Worcester Co.* (Pop., 6,464; est., 7,000.) On Quinnebaug river. Engaged in manufacturing. Incorp. Has sewers and electric lights.

History.—Built in '81 by Southbridge Water Supply Co. Engrs., Buttrick & Wheeler.

Water Supply.—Springs and surface water, by gravity. Drainage area, 179 cres.

Dam and Reservoir.—Cap., not given; 200 x 230 ft.; area, 5 acres; elevation, 100 ft. above village. Dam of earth, 240 ft. long, 18 ft. high, 57 ft. thick at base, 10 at top. Inner side protected by stone wall 8 ft. thick at base, 6 at top, battered on wet face. *Discharge-pipe:* 12-in., extends through dam, and has cut-off wall. Cost, $15,000. Contr., Thos. Hennessy, Holden.

Supply Main.—Diam., 12 ins.; length, not given.

Distribution.—*Mains*, c. i., 5 miles; laid by Inman Bros., New York City. *Services*, w. i. *Taps*, 250. *Meters*, none. *Hydrants*, Mathews, 25. *Valves*, Chapman.

Consumption, about 25,000. *Pressure*, 52 lbs.

Financial.—Cost, $25,000. Cap. stock, $18,000. Debt, $7,500. Int., 4%. Ann. op. exp., $350. Ann. rev.: consumers, $1,800; city, $850. Hydrant rental, $30.

Management.—Prest. and Supt., F. L. Chapin. Secy. and Treas., F. W. Eaton.

SOUTH FRAMINGHAM, *Middlesex Co.* (Pop., est., 5,500.) Manufactures boots, shoes, straw and rubber goods. Incorp. Has sewers and electric lights.

History.—Built in '85 by Framingham Water Co. Engr., A. H. Howland, Boston. Contr., Wm. C. McClallan, deceased, Boston.

Water Supply.—Farm pond and Sudbury river, filtered, direct pumping.

Filter Galleries.—Alongside, and partly beneath pond; is in two sections, with pump well and pumping station between them. One section is 200, and the other 250 ft. long, and each is about 48 ins. high and 42 to 48 ins. wide, arched; arch is water tight, and no water can enter gallery without first passing through at least 5 ft. of filtering material. Bottom of gallery is about 6 ft. below surface of pond. There is direct connection between pump-well and pond, and also between pump-well and Farm pond conduit of the Boston water-works.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two 1,500,000 Deane pumps, one low and one high-pressure. *Boilers:* horizontal, tubular, from R. F. Hawkins, Springfield.

Distribution.—*Mains*, 16 to 4-in. c. i., 11 miles. *Services*, 1 to ½-in. lead. Pipe and specials from Warren Foundry & Machine Co., Phillipsburgh, N. J.; laid by Lewis & Eglee, *now* C. H. Eglee, Flushing, N. Y. *Taps*, 550. *Meters*, Crown, 75. *Hydrants*, Coffin, 75. *Valves*, Coffin.

Consumption, 260,000 galls. *Pressure:* Ordinary, 80 lbs. Fire, 80 to 100 lbs.

Financial.—Cost, $250,000. Cap. stock, $125,000. Bonded debt, $125,000. Int., 6%. Ann. op. exp., about $7,500. Ann. int., $7,500. Ann. rev.: consumers, $10,000; city, $3,125.

Management.—Prest, Willis M. Ranney. Treas., Geo. E. Cutler. Secy., Sidney A. Phillips. Supt., A. E. Martin.

SOUTH HADLEY FALLS, *Hampshire Co.* (Pop., 2,750; est., 3,500.) On Connecticut river. Incorp. Has sewer and electric lights.

History.—Built in '72 by village. Des. Engr., W. B. Harris. Const. Engr., E. C. Davis.

Water Supply.—Buttery brook, by gravity from storage reservoir.

Dam and Reservoir.—Cap., not given; area, about 2 acres; av. depth, 8 ft. Dam of earth, 200 ft. long, 8 ft high, with 3-in. plank in centre. Cost, $2,000.

Supply Main.—C. i., 7,080 ft. long; 3,840 ft. of 12, 3,240 ft. of 10-in.

Distribution.—*Mains*, c. i., 13 miles. *Services*, lead, w. i. *Taps*, 425. *Meters*, 1. *Hydrants*, Perkins, 54. *Valves*, Chapman.

Consumption, unknown. *Pressure*, 70 lbs.

Financial.—Cost, $75,000. Debt, $40,000. Int. 7%. Ann. op. exp., $1,000. Ann. rev.: consumers, $4,500; city, $200. First cost, $55,717.

Management.—Comrs. Prest., H. P. Street. Secy. and Treas., Fred M. Smith. Supt. M. L. Barnes.

SPENCER, *Worcester Co.* (Pop., 7,466; est., 9,000.) On Seven Mile river, on very broken ground. Manufactures boots, shoes, woolen cloth and wire. Settled in 1686; incorp. town in 1753. Has sewers and electric lights.

History.—Built in '83 by Spencer Water Co. and bought by city Jan. 1, '84. Engr., S. C. Heald, Worcester. Contrs., Goodhue & Birnie, Springfield.

Water Supply.—Shaw's pond, by gravity. Small dam creates pond of 67 acres, 200 ft. above, and 1 miles from, village; drainage area, ¼ sq. m.

Distribution.—(In '87.) *Mains*, 14 to 2-in. c. i., w. i. and cem., 13 miles. *Services*, w. i. and cem. *Taps*, 800. *Meters*, none. *Hydrants*, Holyoke, 88.

Consumption, unknown. *Pressure*, 70 lbs.

Financial.—(In '87.) Cost, $240,097. Debt, $240,000. Int., 4 %. Ann. op. exp., $888. Ann. rev.: consumers, $19,334; city, $5,000. Hydrant rental, $50 for first 50, $40 for additional.

Management.—Supt., Dexter Bullard.

SPRINGFIELD, *Hampden Co.* (Pop., 33,340; est. 40,000.) On east bank of Connecticut and Mill rivers, western part being level and eastern part on high ground rising gradually from city. Has large and various manufactories. Settled in 1636; incorp. city in '32. Has sewers and electric lights.

OLD WORKS.

General Description.—In '43, pop. being 11,000, Chas. Stearns built reservoir and laid 3 miles of 4, 6 and 7-in. bored wooden logs. In '45 these works were enlarged and the Springfield Aqueduct Co. organized; they built four reservoirs, known as Lombard, Heywood, Chapin and Worthington. In '67, wooden pipes were replaced by w. i. and cem., and east Van Horn reservoir constructed; Lombard reservoir was subsequently enlarged and west Van Horn reservoir constructed. In '60, city sunk well and City Aqueduct Co. was incorp., but soon dissolved. In '74, city bought these works.

PRESENT WORKS.

History.—Present works built in '73-5 by city. Supplies Ludlow. Engr., Phineas Ball, Worcester. Work done by city.

Water Supply.—By gravity, from impounding reservoir in Ludlow and Belchertown.

Ludlow Impounding Reservoir.—Cap., 1,992,389,000 galls.; area, 445 acres; drainage area, 10.82 sq. m., with water surface 402 ft. above city datum. The reservoir is formed by two dams known as the Cherry Valley and Ludlow, described below. Most of area flooded had sand and gravel soil; there was small area of marsh and 281 acres of woodland, the remainder having been under cultivation. The marshy area was covered with 18 ins. of sand, and the area between Ludlow dam and filtering dam with 2 ft. of sand.

Cherry Valley Dam.—Earth, with masonry heart-wall; 2,352 ft. long, 39 ft. above natural surface, and 47.6 ft. above foundation, at highest point; top of bank 25 ft. wide; both slopes 2 to 1; inner slope has from 1 to 2 ft. of rubble paving, covered with about 6 ins. of selected hardpan to fill interstices; 1,021 ft. of length is only from 3 to 5 ft. high. At first high-water was 4 ft. below top, but lately it has been kept 10 ft. below. Site of dam was excavated to hardpan from foot of inner slope to a line 20 to 30 ft. back of heart-wall. The whole bank was puddled, the inner part being of compact, bluish hardpan, in 1½ to 2-ft. layers, flooded with water; outer part of loam. All stone above 4 ins. in diam. were excluded from bank. Top of dam covered with 1½ to 2 ft. of loam. A dry stone drain, 5 ft. sq., extends along lower toe of dam.

Heart-wall: rubble masonry in cement, 1,297 ft. long, 18 ins. thick, carried from 1 to 3 ft. below bottom of dam, and within 2 ft. of top; top protected from action of frost by dry rubble stone walls, 2 ft. deep and 18 ins. thick on each side.

Spillway and Canal: in south end of dam, spillway resting on ledge, paved with stone, 34 ft. wide, 4⅔ ft. deep; canal in center provided with gates in gate-house at intersection of canal and overfall. Two lower gates are of iron, each 6 ft. 2 ins. high by 2½ ft. wide, resting on granite sill 19 ft. below surface of overfall in spillway. From cap-stone to surface of overfall plank gates are fitted in grooves cut in the masonry. Canal gate-house of masonry, thoroughly constructed. Canal extends 120 ft. above and 330 ft. below overfall, is 8 ft. wide at bottom, has slopes 1 to 1, lined with boulders from 1½ to 3 ft. thick, interstices filled with concrete. Bottom and slopes connected by easy curves. Slope of canal outside gates is 2 ft. in 100; inside about 1 ft. in 120. The gates and hoisting machinery are covered with corrugated iron building, 10 x 37 ft., extending across overfall

Canal and gates were made advisable by leakage of dam at its foundation. Gates form safety-valve to reservoir, as, with water at level of spillway, two iron gates have cap. of 570 cu. ft. per second; by raising plank gates above, added discharge 195 cu. ft. per second is gained. *Discharge-pipe:* abandoned. Was 20 ins. in diam., enclosed in stone wall, extended through dam, had gate at each end, inner one being parallel to slope and operated from top of dam by rod.

Built in '74. Cost, not given. Engr. and Contr., see History.

Ludlow Dam.—Earth, with masonry and concrete heart-wall; 496 ft. long, 18 ft. high above bottom of reservoir, 22 above foundation, with top 4 ft. above high-water; 35 ft. wide on top, with inner slope 2 to 1, paved like Cherry Valley dam; outer slope graded out in rolling manner to nearly 4 to 1. Whole dam rests on solid gravel; built up in 8 to 10-in. layers of sand, with a small per cent. of loam, flooded. *Heart-wall:* rubble-stone in cement, with 4 to 6-in. rammed concrete core, 3½ ft thick, carried within 2 ft. of top of dam and 18 ins. below bottom. *Spillway:* none; see Cherry Valley dam. *Gate-house:* masonry, 18½ x 19½ ft. on outside; can be divided into 3 chambers by planks sliding in masonry grooves. *Discharge-pipes:* two; 24-in. supply pipe, and 30-in. pipe for additional supply, if desired. Built in '74. Cost, not given. Engr. and contr., see History.

Filter.—Abandoned as useless. Across ravine, and above Ludlow dam, dry rubble wall was built, leaving space about 100 ft. wide, with area of 4 acres. Bottom of this space was covered with sand, and above this frames were placed for filling with filtering material. These had vertical movement, and were to be raised and lowered for cleaning by means of derricks on a bridge above.

Canals.—Water from two brooks is conveyed to reservoir by a 5,278-ft. canal with grade of 3.7 ft. to the mile, from Higher brook, and by a 11,930-ft. canal, with only 1 ft. fall, from Broad brook.

Conduit.—To city from Ludlow dam, 56,410 ft. long, 24 ins. in diam.; first 3,736 ft. of c. i.; remainder w. i. and cem., except that the Chicopee river is crossed by a 168-ft. bridge, the upper chords of which are two 26-in. tubes, 12 ft. apart, which form conduit at this point, and are made of ⅜-in., riveted boiler plate, lined with cem. after erection. Contrs. for w. i. and cem. pipe, Goodhue & Birnie, Springfield, Mass. Engr. and contr. for bridge, Jno. R. Smith.

Distributing Reservoirs.—Combined cap., 110,570,000 galls. High service is directly from impounding reservoir, and low service from high, through regulator valve, and also through Van Horn and Lombard reservoirs. Elevation of each, 193½ ft. above city datum.

Upper Van Horn: cap. 28,000,000 galls.; area, 9½ acres; depth, 24 ft.

Lower Van Horn: cap. 73,600,000 galls.; area, 13½ acres; depth, 30 ft.

Lombard: cap., 8,970,000 galls.; area, 3 acres; depth, 23 ft.

Distribution.—*Mains*, c. i., w. i. and cem., 85 miles. *Services*, w. i. *Taps*, 5,147. *Meters*, 556; mostly Crown, Union, Desper and Worthington, with a few Ball & Fitts, Undine and Whittier. *Hydrants*, Chapman, 557. *Valves*, Chapman. *Close of '75*: Mains, 55 miles. Families supplied, 3,850. Meters, none recorded. Hydrants, 300. *Close of '80*: Mains, 64 miles. Families supplied, 4,894. Meters, 44. Hydrants, 381.

Consumption, 4,000,000 galls. *Pressure*, 90 to 120 lbs.

Financial.—Cost, $1,349,574. Debt, $1,200,000: $1,000,000 at 7, $200,000 at 6 %. Sinking fund, none. Ann. op. exp., $28,339. Ann. int., $82,000. Ann. rev.: consumers, $129,464; city, $15,735. Hydrant rental, $20. Cost to close of '75, $1,146,279; '80, $1,216,847. Rev. for '75, charged, $52,100; '80, charged, $65,702.

Management.—Three Comrs. Chn., H. Q. Sanderson. Registrar, A. R. Hathaway. Supt., J. C. Hancock.

Reference.—Tenth Census U. S., Vol. XVII., Water Supply of Cities, pp. 34-8.

STATE ALMSHOUSE, *Tewksbury, Middlesex Co.* (Pop., not given.)

History.—Built in '79 by State.

Water Supply.—Surface water, by pumping through stand-pipe to reservoirs.

Pumping Machinery.—Dy. cap., about 500,000 galls.; 335,000 Worthington com., dup. and Blake No. 7.

Stand-Pipe.—Cap., 264,000 galls.; 30x50 ft., 10 ft. added in '89.

Reservoirs.—Cap., 2,000,000 galls.; two, of 1,000,000 galls. each.

Distribution.—*Mains*, c. i., 1 m. *Services*, w. i. *Taps*, 2. *Meters*, none. *Hydrants*, 10.

Consumption, 75,000 galls. *Pressure*, 33 lbs.

Financial.—Cost, about $30,000. No debt. Ann. op. exp. withheld, est., $1,000. Ann. rev., none.

Management.—Trustees of Almshouse. Supt., C. I. Fisher. Engineer, A. S. Young.

STATE FARM, *Bridgewater, Plymouth Co.* (Pop., about 450.)

History.—Built in '85 by State.

Water Supply.—Taunton river, pumping to stand-pipe.

Pumping Machinery.—Not described.

Stand-Pipe.—Cap., about 90,000 galls.; 17x55 ft.; open at top. No other data.

STOCKBRIDGE, *Berkshire Co.* (Pop., 733; est., 2,100.) On Housatonic river, on uneven ground. Settled in 1718; incorp. in 1739. No sewerage or electric lights.

History.—Built in '62 for domestic supply by Stockbridge Water Co. Authority to obtain additional supply has been secured from Legislature, and M. M. Tidd, Boston, engaged to investigate the matter in '89.

Water Supply.—Springs, surface water and 300-ft. artesian well, by gravity and pumping to reservoir. Gravity supply from impounding reservoir. Drainage area, 500 acres.

Dam and Impounding Reservoir.—Cap., not given; dam, stone and cem., 60 ft. long by 12 ft. high; built across ravine at base of mountain. Cost, $14,000.

Filter.—Alternate layers of perforated tile, charcoal and gravel, enclosed by brick walls 15 x 10 ft., x 14 ft. deep.

Supply Main.—Iron, 4-in., 2 miles long.

Pumping Machinery.—Dy. cap., 400,000 galls.; Knowles.

Distributing Reservoir.—Cap., 250,000 gals.

Distribution.—*Mains*, c. i., 3 miles. *Services*, galv. i. *Taps*., 100. *Meters*, none. *Hydrants*, Holyoke, 6.

Consumption and *Pressure*, unknown.

Financial.—Cost, $18,000. Cap. stock, $7,000. Bonded debt, $9,400: $1,000 at 6, $8,400 at 5%. Ann. op. exp., from $300 in wet year to $900 in dry year. Ann. rev.: consumers, $1,400; city none. Cost at close of '80, about $7,000.

Management.—Prest., D. R. Williams, Secy. and Treas., D. A. Kimball. Comr., F. S. Ayman.

STONEHAM, *Middlesex Co.* See Wakefield.

STOUGHTON, *Norfolk Co.* (Pop., 4,875; est., 5,173.) Manufactures boots and shoes. Not incorp. No sewers. Has electric lights.

History.—Built in '86 by Jno. G. Phinney; now known as Stoughton Water Co. Des. Engr., E. A. Hammett and L. A. Taylor. Const. Engr., M. Mason. Contr. for masonry, N. C. Porter, Stoughton.

Water Supply.—Well, pumping to tank. Well 25 ft. in diam., 30 ft. deep.

Pumping Machinery.—Dy. cap., 500,000 galls.: Worthington dup., comp.

Tank.—Cap., 317,000 galls.; 20x60 ft.; from E. Hodge & Co., E. Boston.

Distribution.—*Mains*, iron, 5 miles. *Services*, lead. Pipe and specials from R. D. Wood & Co., Philadelphia, Pa., and M. J. Drummond, N. Y. City. Pipe laid by N. C. Porter, Stoughton. *Taps*, 200. *Meters*, none. *Hydrants*, Mathews, 20. *Valves*, Chapman.

Consumption, 25,000 galls. *Pressure*, 60 lbs.

Financial.—Cost, about $90,000. Cap. stock, $50,000. Bonded debt, $50,000. Int., 6%. Ann. op. exp., withheld, est., $800. Ann. rev.: consumers, withheld, est., $5,000. Hydrant rental, offered at $60; not decided time of report.

Management.—Prest., Chas. W. Lunn. Treas., E. R. Stickney, Springfield. Supt. and Sec., Frank F. Phinney.

SUNDERLAND, *Franklin Co.* (Pop., est., 300.) No sewers or electric lights.

History.—Built in '83 by Sunderland Water Co., for domestic supply.

Water Supply.—Springs, by gravity to small reservoir.

Distribution.—*Mains*, lead, 2 miles. *Services*, lead. *Taps*, 43. *Meters* and *Hydrants*, none.

Consumption, 50,000 galls. *Pressure*, 80 ft. head.

Financial.—Cost, $2,200. Cap. stock, $3,000. No debt. Ann. op. exp., "slight," est., $20. Ann. rev.: consumers, $200; city, $20.

Management.—Prest., Joel Burt. Treas., N. A. Smith.

SWAMPSCOTT, *Essex Co.* (Pop., 2,500; est., 2,500.) Engaged in fishing; summer resort. Settled in 1625; incorp. town in '52. No sewerage. Has electric lights.

TOWN PLANT.

History.—Distribution built in '83-4 by town. (See Water Supply.)

Water Supply.—Marblehead Water Co.'s plant since '85; previously, from Lynn.

Distribution.—*Mains*, 10 to 4-in. w. i. and cem., about 5 miles. *Services*, not given. *Taps*, 487. *Meters*, 3. *Hydrants*, Chapman, Holyoke, 100.

Consumption, 400,000 galls.. *Pressure*, 60 lbs.

Financial.—Cost, $100,000. Cap. stock, $75,000. Bonded debt, $75,000. Ann. op. exp., $4,000. Ann. rev.: consumers, $11,000; city, not given.

Management.—See Marblehead Water Co., below.

MARBLEHEAD WATER CO.

History.—Built in '85 to supply water to Marblehead, Swampscott and Nahant, each town owning its distributing plant. In '89 Marblehead (which see) secured its own supply. Co. superintends works in other towns, operating each as division of whole. Engr., A. H. Howland, Boston. Contr., W. C. McClallan, Boston.

Water Supply.—Surface and tubular wells, pumping to stand-pipe. Surface well, 22 ft. in diam., 20 ft. deep, with 6 2½-in. tubular wells, each 40 ft. deep, sunk in its bottom. Also 35 2½-in. tubular wells, 35 to 45 ft. deep.

Suction Pipe.—Diam., 10 ins.; with 8 and 6-in. pipes, connecting with tubular wells.

Pumping Machinery.—Dy. cap., 2,500,000 galls.; two 1,250,000 Deane.

Force Main.—Diam., 12 ins., reduced to 10 ins.

Stand-Pipe.—Cap., about 352,000 galls.; 22½ x 110 ft.

Supply Mains.—A 12-in. to Swampscott and Marblehead; 12-in. to Nahant.

Financial.—Cost, $100,000. Debt, not given. Int., not given. Ann. op. exp., $4,000. Ann. rev.: consumers, gross, from 3 towns, not given, est., $30,000: rebate, not given, est., $6,000. Hydrant rental, $20, on Co.'s pipe; free on pipe owned by town.

Management.—Prest., Thos. Appleton. Secy., E. N. Stickney. Treas., E. P. Bond. Supt., Kendall Pollard.

TAPLEYVILLE, *Essex Co.* In town of Danvers, which see.

TAUNTON, *Bristol Co.* (Pop., 21,213; est., 25,000.) On Taunton river. Manufactures locomotives, machinery, cotton and woolen goods, stoves, rails, buttons, copper and silver ware. Incorp. town in 1639, city in '64. Has sewers and electric lights.

History.—Built in '76 by city. Engr., Geo. H. Bishop, Middletown, Conn.

Water Supply.—Ground water and 7 driven wells, with Taunton river for emergency, by direct pumping.

Filter Galleries.—*Old:* 100 ft. from Taunton river at low-water, 400 ft. long, has slopes of 2 to 1, and is 17 ft. wide at depth of 8 ft. below mean low-water mark. Slopes paved with stone from 18 ft. from bottom, and sodded above.

New: In '80 an egg-shaped brick conduit, with open end joints, was built alongside, and 40 ft. from river; 863 ft. long, 4 ft. wide and 5 ft. 2 ins. high; bottom on level with that of river. In '84 this was extended 90 ft. 7 in., and a filter bank built between it and river. A 36-in. w. i. pipe laid 4 ft. below bottom of river, leads to pump-well.

Intake Crib and Pipe.—Double plank crib, outer being 18x20, inner 10x12 ft.; plank 2 ins. apart, vertically. Space between cribs filled with broken stone. Pipe 30 ins. in diam, length not given. Used to take water directly from river.

Pump-Well.—Is 28 ft. deep. No other data.

Pumping Machinery.—Dy. cap., 4,000,000 galls.; Holly; a 3,000,000 quadruplex, with 14-in. steam cylinders, 9¾-in. pumps, all of 24-in. stroke. Also for fire-pressure, two 500,000 Holly rotary, driven by horizontal high-pressure engine.

Force Main.—Not described.

Distribution.—*Mains,* 22 to 4-in. c. i., 55.86 miles. *Services,* w. i. and cem. Pipes and specials from, and pipe laid by, R. D. Wood & Co., Philadelphia, Pa. *Taps,* 3,027. *Meters,* mostly Union and Crown, 858. *Hydrants,* Chapman, Mathews, Ludlow, 487. *Valves,* kind, do. *Nov.* 30, '80: Mains, 33.07 miles. Taps, 1,608. Meters, 258. Hydrants, 284.

Consumption, 751,882 galls. *Pressure:* Ordinary, 55 lbs. Fire, 100 lbs.

Financial.—Cost, $558,229. Bonded debt, $523,700: $250,000 at 6, $30,000, at 4½ and $253,700 at 4%. Int., 4 to 6%. Sinking fund, $210,475. Ann. op. exp., $14,168. Ann. int., $26,123. Ann. rev.: consumers, $39,444; misc., $162; city, $8,130. Hydrant rental, $6,000 for all, or about $12.70. First cost, about $250,000. Cost to Nov. 30, '80, $338,333. Rev., year ending Nov. 30, '80, $25,581.

Management.—Three Comrs. Prest., Parley J. Perrin. Supt. and Clerk, Geo. F. Chase.

Reference.—Tenth Census U. S., Vol. XVII., Water Supply of Cities, p. 223.

TURNER'S FALLS, *Franklin Co.* (Pop., est., 4,000.) On Connecticut river. Has several manufactories. Settled in '66; incorp. fire district in '70. Has sewers and electric lights.

History.—First supplied in '73 by private Co. Present works were built in '86-7 by fire district. Engr., Percy M. Blake, Hyde Park. Contr. for masonry and buildings, Jno. Lapoint, Turner's Falls. First system was built after plans by William P. Crocker, supply being taken from springs and afterwards increased by pumping from river to reservoir. There were 10 hydrants.

Water Supply.—Lake Pleasant, pumping to reservoir; area of lake, 45 acres.

Pumping Machinery.—Dy. cap., 1,250,000 galls.: Deane dup., comp., cond.

Reservoir.—Cap., 1,300,000 galls.; at elevation of 281.8 ft. above canal in village; circular, with inner slopes paved with granite blocks. Contrs., Thomas Bros., Turner's Falls.

Distribution.—*Mains,* c. i. (in '87) 10 miles. *Services,* w. i. Pipe and specials from Warren Foundry and Machine Co., Phillipsburgh, N. J.; laid by Chas. H. Egloe, Flushing, N. Y. *Taps,* 261. *Meters,* 3. *Hydrants,* Ludlow, 53. *Valves,* Peet.

Consumption, 246,526 galls. *Pressure,* 100 lbs.

Financial.—Cost, to May, '89, $104,896. Bonded debt, $100,000. Int., 4%. Ann. op. exp. (in '87), $2,000. Sinking fund, $4,000. Ann. rev.: consumers, $6,245. Hydrants owned by fire department; no rental.

Management.—Three Comrs. Secy., H. D. Bardwell. Treas., M. B. Collins. Supt., W. W. Chase.

UXBRIDGE, *Worcester Co.* (Pop., 3,111; est., 3,000.) Has cotton and woolen and gun manufactories. Incorp. in '80. No sewers or electric lights.

History.—Built in '80 by Uxbridge Water Co. Engr., A. W. Bennett. No general contractor.

Water Supply.—Springs, by gravity through covered trenches to reservoirs.

Dam.—Not described. Cost, $6,000.

Reservoirs.—Combined cap., est., 400,000 galls.; covered; one 60x80 ft., x 10 ft. deep, and one 25 ft. in diam. by 15 ft. deep; 137 ft. above and ¼ mile from town.

Distribution.—*Mains*, c. i., 2 miles. *Services*, w. i. *Taps*, 90. *Meters*, 16. *Hydrants*, Chapman, 24 *Valves*, Chapman.

Consumption, 3,000 galls. *Pressure*, 62 lbs.

Financial.—Cost, $26,000. Debt, $20,000. Int., 5%. Ann. op. exp., $200. Ann. rev.: consumers, $1,800; city, $360. Hydrant rental, $15. First cost, $3,800.

Management.—Prest., Geo. F. Day. Supt., Secy. and Treas., C. A. Taft.

VINEYARD HAVEN, *Dukes Co.* (Pop., est., 1,500.) Not incorp. No sewers or electric lights.

History.—Built in '87 by Vineyard Haven Water Co. Engr., O. G. Stanley, Vineyard Haven. Consult. Engr., M. M. Tidd, Boston. Work done by company.

Water Supply.—Tashmoo springs, pumping to stand-pipe. Springs are collected in covered gallery, on shore of Lake Tashmoo, 38 ft. long, 7 ft. wide, 10 ft. high.

Pump-Well.—Is 7x13 ft., x8 ft. deep.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Blake.

Stand-Pipe.—Cap., 117,000 galls.; 20x50 ft.; from E Hodge & Co., East Boston.

Distribution.—*Mains*, c. i., 3 miles. *Services*, lead. Pipe from Gloucester Iron Works, Philadelphia, Pa., and Warren Foundy & Machine Co., Phillipsburgh, N. J.: specials from Builders' Iron Foundry, Providence, R I. *Taps* (in '87), 64. *Meters*, 3. *Hydrants*, Ludlow, 11.

Consumption, unknown. *Pressure:* Ordinary, 52 lbs. Fire, direct pumping, amount not given.

Financial.—Cost (in '88), $50,000. Debt (in '88), $20,000. Int., 6% Ann. op. exp., $900. Ann. rev.: consumers, $1,200; city, $500. Hydrant rental, $50.

Management.—Prest., Chas. C. Jackson. Treas., Francis Peabody, Jr. Supt., A. F. Cummings.

WAKEFIELD and STONEHAM, *Middlesex Co.* (Pop.: Wakefield, 5,547; est., 5,500. Stoneham, 4,890; est., 6,000.) Manufacture iron castings, boots and shoes, rattan goods and pianos. Wakefield not incorp.; no sewers or electric lights. Stoneham settled in 1620; incorp. town in 1725.

History.—Built in '83 by Wakefield Water Co. to Supply Wakefield and Stoneham, jointly. Engr., Percy M. Blake, Hyde Park.

Water Supply.—Crystal lake, pumping to stand-pipe. Area of lake, 60 acres.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two, 1,500,000, Knowles dup.

Stand-Pipe.—Cap., 565,000 galls.; 40x62 ft.; at elevation of 200 ft. above pumps; 185 ft. above Wakefield, and 125 ft. above Stoneham.

Distribution.—*Mains*, 12 to 4-in. w. i. and cem., about 49 miles. *Services*, c. i. *Taps*, 1,600. *Meters* (in '87). *Hydrants*, kind not given, 136.

Consumption, 550,000 galls. *Pressure*, 80 lbs.

Financial.—Cost, withheld, est., $400,000. Cap. stock, authorized, $300,000; paid up, $50,000. Bonded debt, $300,000. Ann. op. exp., $5,000. Ann. rev.: consumers, withheld, est., $22,000; cities, $6,740. Hydrant rental, $50 for 114, and $40 for 22.

Management.—Prest., David H. Darling. Secy. and Treas., C. O. Burbank. Supt., Geo. W. Harrington.

WALTHAM, *Middlesex Co.* (Pop., 11,712; est., 16,000.) On Charles river, 10 miles from Boston, on level plain about 2½ m. sq., surrounded by high wooded hills. Has water-power from river, and manufactures watches. Incorp. town in 1738; city in '84. No sewers. Has electric lights.

History.—Built in '73 by town. Des. Engr., Edw. Sawyer. Const. Engr., Jos. H. Curtis. Contrs., Ferris & Halladay, Jersey City, N. J.

Water Supply.—Open filter basin near Charles river, pumping to reservoir. River above Waltham has drainage area of about 200 sq. m.

Filter Basin.—In gravel excavation; area, ¼ acre; depth, 8½ ft. No cleaning Conduit 65 ft. long conveys water to pump-well.

Pumping Machinery.—Cap., 3,000,000 galls.; two Worthington comp., with 14 in. high-pressure and 30-in. low-pressure steam, and 14-in. water cylinders, all of 18-in. stroke; one made in '73, one in '80. *Boilers:* one 60 H. P., made by Cunningham Iron Works, Boston, and one 111 H. P. Roberts boiler.

Force Main.—Is 16 ins. in diam. and 2,600 ft. long; head on pumps, 164 ft.

Reservoir.—Cap., 6,000,000 galls.; in natural gorge, with puddled walls at ends; 230 by 260 ft. with semicircular ends of 105 ft. radius; both slopes 1½ to 1, inner paved with 12 ins. of granite; 165 ft. above pumps and 138 ft. above highest street level.

Supply Main.—W. i. and cem., 16-in., 2,629 ft. long.

Distribution.—*Mains*, 24 to 2-in. c. i. w. i. and cem., 36½ miles. *Services*, 6 to ¾-in. w. i. and cem. *Taps*, 2,197. *Meters*, 27. *Hydrants*, Whittier, Chapman, 197. *Close of* '80: Mains, 22½ miles. Taps, 1,135. Meters, 11. Hydrants, 121.

Consumption, 534,063 galls. *Pressure*, 56 lbs.

Financial.—Cost, $412,000. Debt, $397,000: $125,000 at 6 6-10, $30,000 at 4½, and $240,000 at 4%. Sinking fund, $18,593. Ann. op. exp., $27,393 (for '87, $26,702, instead of $29,702, as given in '88 MANUAL). Ann. int., $18,800. Ann. rev.: consumers, $36,668; misc., $2,964; city, $4,540. Hydrant rental, $20. Cost at close of '80, $298,835. Rev. for '80, $20,116.

Management.—Three Comrs. Chn., W. H. Wrenn. Supt., Geo. E. Winslow. Clerk, Leroy Brown.

WARE, *Hampshire Co.* (Pop., 4,817; est., 7,800.) Manufactures cotton and woolen goods. Sewers built in '89. Has electric lights.

History.—Built in '86-7 by town. Engr., F. L. Fuller, Boston. Contrs. for pumping station, Aldrich & Hill, Ware.

Water Supply.—Collecting well, pumping to reservoir. Well, 26 ft. in diam., 22 ft. deep. Contrs., Keogh & Shaw, Providence, R. I.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Deane, comp., cond., with 12 and 22-in. high and low-pressure cylinders, 12-in. plunger and 18-in. stroke. *Boiler*, from W. Allen & Sons.

Reservoir.—Cap., about 1,500,000 galls.; 97½ x 154½ ft. at top, 92½ x 149 ft. at bottom and 15 ft. deep from high water. Contr., F. A. Snow, Providence, R. I.

Distribution.—*Mains*, c. i., 7¾ miles. *Services*, w. i. and cem., 3.7 miles. Pipe from Warren Foundry & Machine Co., Phillipsburgh, N. J., and McNeal Pipe & Foundry Co., Burlington, N. J.; laid by Jno. T. Langford, Newton. *Taps*, 350. *Meters*, 87. *Hydrants*, Chapman, 56. *Valves*, Chapman.

Consumption, 133,359 galls. *Pressure*, 85 lbs.

Financial.—Cost, $84,395. Debt, $73,800: $54,000 at 3½ and $19,800 at 4%. Ann. op. exp., $5,282. Ann. rev.: consumers, 5,100; city, $1,362. Hydrant rental, $20.

Management.—Three Comrs. Supt., Fred A. Volk.

WARREN, *Worcester Co.* (Pop., 3,889; est., 4,500.) Has steam pump works and cotton and woolen factories.

TOWN PLANT.

General Description.—Date built not given. Fire protection only. Water pumped from Wigwam pond by Knowles pump, operated by Knowles Steam Pump Works. *Mains*, not given. *Hydrants*, 10. Town Clerk, S. E. Blair.

WARREN AQUEDUCT CO.'S PLANT.

History.—Built in '37.

Water Supply.—Three springs, by gravity from small collecting well at each. Two of wells are each 2½ x 16 ft., x 14 ft. deep, and third is 2½ ft. in diam., 20 ft. deep.

Distribution.—*Mains* and *Services*, lead, former about 2 ins. in diam.; length not given. *Families supplied*, about 20.

Management.—Address Silas Hobbs.

AQUEDUCT CO.

History.—Built in '72.

Water Supply.—Eight wells, or springs, on Mark's Mt., by gravity

Distribution.—*Mains*, lead. *Families supplied*, about 20.

Management.—Address Henry Greene.

JOSEPH W. HASTINGS' PLANT.

History.—Built in '75.

Water Supply.—Springs on mountain.

Distribution.—*Mains*, w. i. and cem., c. i., ¾ miles; originally all w. i. and cem. *Families supplied*, 20.

Management.—Owned by Jos. W. Hastings.

WILSON H. FAIRBANKS' PLANT.

General Description.—Has two lines of pipe. No other data.

WATERTOWN, *Middlesex Co.* (Pop., 5,426; est., 7,000.) Is 8 miles from Boston. Has various manufacteries. Incorp. No sewers. Has electric lights.

History.—Built in '84 by Watertown Water Supply Co. Engr. Wm. Wheeler, Boston.

Water Supply.—Filter galleries near Charles river; direct pumping and pumping to tank.

Filter Galleries.—In three sections, all on same level. First section, 190 ft. long, 15 ft. wide, contains 12 to 15 ft. of water; second section, conduit 175 ft long, 3 ft. wide and 2 ft. high; third section, at right angles to the second, 102 ft. long, 8 ft. wide.

Pumping Machinery.—Dy. cap., 1,500,000 galls; two Deane, one 1,000,000 comp., cond., one 500,000.

Tank.—Cap., 300,000 galls; 40 x 40 ft.

Distribution.—*Mains*, 12 to 6-in., w. i. and cem., about 23 miles. *Services*, enam. i. *Taps*, 750. *Meters*, 20. *Hydrants*, Ludlow, Chapman, Coffin, 179.

Consumption, 275,000 galls. *Pressure*, 90 lbs.

Financial.—Cost, withheld, est., $230,000. Cap. stock, debt and int., withheld. Ann. op. exp., withheld, est., $4,000 ann. rev.: consumers, withheld, est., $15,000; city, about $6,000. Hydrant rental, $35.

Management.—Prest., A. O. Davidson. Secy., S. S. Gleason. Treas., J. H. Conant. Supt., Jno. H. Perkins.

WEBSTER, *Worcester Co.* (Pop., 5,696; est., 7,000.) Manufactures cotton, woolen and linen goods and shoes. Has electric lights.

History.—Built in '68 by H. N. Slater, and run in connection with his woollen mill. Work done under supervision of Thos. K. Bates.

Water Supply.—Lake Chaubunagungamaug, pumping to reservoir and direct pumping for fire pressure. Lake has area of 1,250 acres; drainage area, 7 sq. m.

Pumping Machinery.—Cap., 432,000 galls.; Crocker's "twin rotary supply pump," No. 2, made by William Clark & Co., Pittsfield.

Reservoir.—Cap., about 1,000,000 galls.; 75x300 ft., x8 ft. deep.

Distribution.—*Mains*, 6 and 4-in. c. i., 6 miles. *Services*, galv. i. *Taps*, 220. *Meters*, 6. *Hydrants*, Chapman. *Valves*, Chapman.

Consumption, 200,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 125 lbs.

Financial.—Cost, about $35,000. No debt. Ann. op. exp., cannot be separated from those of mill. Ann. rev.: consumers, $3,300; city, $560. Hydrant rental $500 for fire purposes, regardless of number.

Management.—By owner, H. N. Slater. Supt., Thos. K. Bates.

WELLESLEY, *Norfolk Co.* (Pop., est., 3,000.) No sewers or electric nights.

History.—Built in '84 by town. Engr., F. L. Fuller, Boston. Contr., Jno. T. Langford, Boston. Consult. Engr., M. M. Tidd, Boston

Water Supply.—Filter gallery and well, direct pumping and pumping to reservoir. Well added in '86; 22 ft. deep, at William's spring, 1,000 ft. distant; connected with pump-well by siphon.

Filter Gallery.—About 400 ft. from Charles river, close to brook leading from Longfellow's pond. Made by excavating pit, 12 ft. wide at top, 11 at the bottom, 20 ft. deep and 63 ft. long, and lining sides with dry stone wall 5 ft. thick at bottom and 2½ at top. Water enters through sides and bottom. In case of emergency water is taken directly from brook.

Pump-Well.—At north end of filter, 5x10 ft; 20-in. brick-work, connected with filter by a 20-in. gate.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Blake comp., cond., dup., with 12-in. high-pressure and 22-in. low-pressure steam cylinders, and 10-in. water plunger-all 18-in. stroke. *Boilers:* two horizontal, from Whittier Machine Co., Boston.

Force Main.—Diam., 12 ins.; length, about 12,000 ft.

Reservoir.—Cap., 1,150,000 galls.; on Mangus hill; 133½ ft. sq. at top, 73½ at bottom; inner slopes, 1½ to 1; outer, 2 to 1; bank, 15 ft. wide on top. Corners rounded. Inner slopes first covered with 10 ins. of concrete, composed of 2½ parts of broken stone or screened gravel to 1 part of cement mortar made of two parts sand to 1 part of F. O. Norton's cement; over this is a 6-in. layer of broken stones, then a 12-in. stone paving. Bottom of reservoir covered with 6-in. layer of concrete sloping in all directions toward 6-in. drain-pipe.

Gate-House.—The 12.-in. force main passes through and 38 ft. beyond gate-house and terminates in an ½ in. bend. The gate chamber and gate-house are of brick, former having 16-in. walls to water-line and 12-in. above, latter 12-in walls all the way. Two check-valves and a gate regulate flow in and out of reservoir, water passing out going through two sets of ¼-in. mesh copper wire screens.

Distribution.—*Mains*, c. i., 19.6. *Services*, iron. C. i. pipe from McNeal Pipe & Foundry Co., Burlington, N. J.; and specials from Builder's Iron Foundry, Providence, R. I. *Taps*, 412. *Meters*, 66. *Hydrants*, Ludlow, Chapman, 126. *Valves*, kind, do.

Consumption, 128,156 galls. *Pressure:* Ordinary, 70 lbs. Fire, 119 lbs.

Financial.—Cost, $175,484. Bonded debt, $161,000. Int., 4%. Sinking fund, $11,780. Ann. op. exp., $2,971. Ann. rev.: consumers, $5,224.60; city, $4,390. Hydrant rental, $20.

Management.—Three Comrs. Treas., Albert Jennings. Secy., F. L. Fuller. Supt., W. H. Vaughn, Wellesley Hills.

NOTE.—For a more extended and fully illustrated description, see *Eng. News*, vol. XIV., pp. 229-31. Also "The Wellesley Water Works," by Frank L. Fuller, an illustrated paper read before the Boston Soc. of C. E., June 17, '85 and printed in the Journal Assoc. Eng. Soc., vol. IV., pp. 401-12.

WESTBOROUGH, *Worcester Co.* (Pop., 5,211; est., 5,500.) On small tributary of Sudbury river, on uneven ground. Manufactures straw goods, boots and shoes. Settled in 1700; incorp. town in 1717. No sewers. Has electric lights.

History.—Built in '78 by town. Engr., C. H. Pierce, Providence, R. I. Engr. on source, and for extensions, Phineas Ball, Worcester, Mass.

Water Supply.—Sandra pond, by gravity. Pond two miles from, and 134 ft. above center of town; formed by building 3 dams; area, 51 acres; drainage area, 1,225 acres; cap., 123,000,000 galls.

Dams.—First dam, at outlet, formerly mill-dam, and consisted of rock and gravel dumped on natural surface. It has been strengthened by stone and cem. wall, laid in trench below, 202 ft. long and from 4½ to 11 ft. high. Of two other dams one was built across bay with puddle heart-wall 105½ ft. long, resting for 89 ft. on quicksand, through center of which sheet-piling was driven; third dam is across ravine, of gravel and loam, faced with stone masonry wall 40 ft. long and 6 ft. high; semicircular, used as wasteway. Supply main is filled from brick gate-house.

Distribution.—*Mains*, 12 to 4-in. c. i., 10½ miles; laid by Inman Bros., N. Y. City. *Services*, w. i. *Taps*, 551. *Meters*, 30. *Hydrants*, Mathews, Chapman, 80. *Valves*, kind, do.

Consumption, unknown. *Pressure*, 55 lbs.

Financial.—Cost, $109,000. Bonded debt, $109,000: $55,000 at 5, $54,000 at 4%. Sinking fund. $15,211; town appropriates $2,000 yearly. Ann. op. exp., $5,968. Ann. rev.: consumers, $16,524; misc., $69. Hydrant rental, free. First cost, $53,000.

Management.—Three Comrs. Chn., R. H. Burke. Clerk, M. G. McCarty.

WESTBOROUGH INSANE HOSPITAL, *Westborough, Worcester, Co.* (Pop. av., about 400.) Owned by State.

History.—Built in '86 by State.

Water Supply.—Tubular wells, pumping to stand-pipe. There are 32 2-in. wells, 50 ft. deep, sunk near outlet to Chauncey pond.

Pumping Machinery.—No data.

Stand-Pipe.—Cap., about 135,000 galls.; 23x40 ft.; iron, open at top, placed on brick tower 70 ft. high.

Distribution.—*Mains*, c. i. *Services*, galv. i., lead. No other data.

Management.—Supt. of Asylum.

WEST BROOKFIELD, *Worcester Co.* (Pop., 1,917; est., 1,800.) No sewer, or electric lights.

TOWN PLANT.

History.—Small system built in '84 by town. Engr., E. C. Davis, Northampton. Fountain was presented to town, to make use of which it was necessary to construct dam and lay some pipe, after which pipe was extended for fire protection. **Water Supply.**—Brook, by gravity. **Distribution.**—*Mains*, iron, 1½ miles. *Taps*, 5. *Meters*, none. *Hydrants*, Chapman, 3. There are also 8 small reservoirs used to store water for fire protection. **Financial.**—Cost, $3,000. Debt, op. exp. and rev., none. **Management.**—Supt., Wm. Dane. Chf. Fire Dept., J. G. Shackley.

WEST BROOKFIELD AQUEDUCT CO.'S PLANT.

History.—Built in '38.

Water Supply.—Wells, by gravity. One well, 160 x 2½ ft., x 8 ft. deep; one, 10 x 2 ft., x 4 ft. deep; both on hill about ¾ miles from village.

Distribution.—*Mains* and *Services*, lead. *Families supplied*, about 40.

Management.—Not given.

QUABOAG AQUEDUCT CO.'S PLANT.

History.—Built in '51.

Water Supply.—Two wells, by gravity.

Distribution.—*Mains* and *Services*, 2 and 1½ in. lead. *Families supplied*, 44.

Management.—Not given.

CEMENT AQUEDUCT CO.'S PLANT.

History.—Built in '68-9.

Water Supply.—Wells, by gravity. One well, 130 ft., other about 35 ft. long; each, 3 ft. wide and 6 ft. deep.

Distribution.—*Mains*, w. i. and cem., length not given. *Services*, lead. *Families supplied*, about 40.

Management.—Not given.

WESTFIELD, *Hampden Co.* (Pop. 7,587; est., 10,000.) On flat land along Westfield river, 10 miles from Springfield. Manufactures paper, steam heaters, whips and cigars. Settled in 1658; incorp. town in 1669. Has sewers and electric lights.

History.—Built in '74 by town. Engr., L. F. Root, Westfield. Consult. Engrs., Shedd & Sawyer, Boston.

Water Supply.—Moose meadow, by gravity from storage to distributing reservoir. Brook has drainage are of 4¼ sq. m., above lower reservoir.

Dam and Storage Reservoir.—Cap., 184,000,000 galls.; area, 30 acres; 30 ft. deep; 771.38 ft. above town. Dam of earth, 350 ft. long, 30 ft. high, 20 ft. wide at top, upper side paved with large stone. *Heart-wall:* stone and cement, 8 ft. thick above foundation, 3 ft. thick at top, which is 2 ft. above water line. *Spillway:* around one end of dam, 20 ft. wide, paved with stone. *Discharge-pipes:* one 6-in., 5½ ft. from water surface, one 20-in. at bottom of reservoir; both fitted with gates. Cost of both dams, $42,000.

Dam and Distributing Reservoir.—Cap., 4,530,000 galls.; 2½ miles from, 479 ft. below storage reservoir, water flowing between the two in rocky channel of brook; 4 miles from, 292 ft. above, town. Dam is 193 ft. long, 28 ft. high, 7 ft. thick at overflow, 14½ ft. thick at bottom above foundation; 50 ft. above this a cut-off wall is built across ravine and space between filled with puddle. Overfall in two parts, total width, 30 ft. Cost, see storage reservoir above. *Gate house:* Below top of dam this is of stone, lined with brick, and has inside dimensions of 12½ x 14½ ft. Water can be introduced either 5 or 14.6 ft. from surface of pond, but is generally taken at former; 6½ ft. lower a 20-in. waste-pipe extends through dam. Arrangements are made to clean gate-chamber and filter water before it passes to town. Above dam gate-house is of brick, 18⅝ ft. sq. Contr., C. D. Allen, Westfield, who also did all masonry work.

Filter.—Not described.

Supply Main.—C. i., 14-in., 4½ miles long. Laid 4¾ ft. below surface, generally, and across Westfield river in trench through rock and gravel; laid to grade with an air-valve at each summit. Thickness and weight of pipe is carefully graded to pressure of each 50-ft. head.

Distribution.—*Mains*, c. i. (in '87), 14 miles. *Services*, galv. i., rubber-coated i. Pipe and specials from Warren Foundry & Machine Co., Phillipsburgh, N. J.; laid by J. J. Marsh, North Adams. *Taps* (in '86), 1,000. *Meters*, 2. *Hydrants*, Ludlow, 137. *Valves*, Ludlow.

Consumption, 1,000,000 galls. *Pressure*, 127 lbs.

Financial.—Cost (in '87). $261,000. Debt, $225,000: $115,000 at 7, $35,000 at 6, $75,000 at 4%. Sinking fund, none. Ann. op. exp., $3,197. Ann. rev.: consumers, $15,225; misc., $11; city, none. Rev. for '75, $5,637; '80, $9,281.

Management.—Comrs. Prest., C. M. Whipple. Clerk, C. N. Oakes. Treas., William Provin. Supt., C. H. Diehl.

WEST SPRINGFIELD, *Hampden Co.* (Pop., village, est., 3,000.) On Connecticut River. Detached from town of Springfield and incorp., in 1774.

History.—Built in '75 by West Springfield Acqueduct Co. Engr., C. L. Goodhue, of Goodhue & Birnie, Springfield, who were contractors, and own stock.

Water Supply.—Darby brook, by gravity from impounding reservoir.

Impounding Dam and Reservoir.—Cap., not given; area, 5 acres. Dam of earth with puddle heart-wall; 250 ft long, 17 ft. high, 20 ft. wide on top. Inner slope, 4 to 1; outer, 1 to 1. Cost, $6.000.

Supply Main.—W. i. and cem.; 16-in.; length not given.

Distribution.—*Mains*, 8 and 6-in., w. i. and cem.; 9 miles, *Services*, lead, enam. i. *Taps*, 399. *Meters*, none. *Hydrants*, 20.

Consumption, not given. *Pressure*, 40 lbs.

Financial.—Cost, $75,000. Cap. stock, $50,000. Bonded debt, $25,000. Ann. op. exp., withheld. est., $1.000. Ann. rev.: consumers, withheld, est., $6,000; city, $1,000. Hydrant rental, about $40. First cost, about $50,000.

Management.—Supt., M. L. Tourtelotte.

WEST STOCKBRIDGE, *Berkshire Co.* (Pop., of town, 1,923.)

History.—Built in '73 by East Mountain Water Co.

Water Supply.—Spring, by gravity.

Dam.—Stone in cem., about 12 ft. long, 6 ft. high, 2 ft. thick. Cost, $200.

Supply Pipe.—W. i., 500 ft. of 2, and 3,500 ft. of 1½-in.

Distribution.—*Mains*, ½-in., about 2,000 ft. *Families supplied*, about 30.

Financial.—Cost, about $2,300. Ann. op. exp., about $10. Ann. rev.: not given, est., $200.

Management.—Not given.

WEYMOUTH, *Norfolk Co.* (Pop., 10,570; est., 10,740.) Composed of villages: Weymouth, Weymouth Landing, North Weymouth, East Weymouth and South Weymouth. Town is on sea coast. Incorp No sewers. Has electric lights.

History.—Built in '85 by town. Des. Engr., M. M. Tidd. Const. Engr., A. H. Howland. Contr., Wm. C. McClallan. All of Boston.

Water Supply.—Weymouth Great pond, by gravity, and for South Weymouth pumping to stand pipe; pressure can be applied to all parts of system, as can direct pumping. Pond, 154 ft. above sea-level; area, 290 acres; drainage area, 631 acres.

Gate-House.—Brick and stone. 8 ft. sq. inside. Water passes to conduit through double set of wire screens.

Conduit.—Begins in gate-house 93 ft. from shore-line, 11 ft. below high-water-mark. First 100 ft., 20-in. c. i. pipe, thence to pumping station, 18-in., where a 14-in. suction pipe takes suppy for the South Weymouth; gravity conduit, extended with 14-in. pipe to Broad and Middle streets; here 12-in. pipe branches off through Broad street to Weymouth Landing and East Weymouth, and 10-in. pipe to North Weymouth, over King hill. Another 10-in. pipe gives second connection with East and North Weymouth and Weymouth Landing.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Blake comp., dup., with 10-in. high, 22-in. low-pressure cylinders, 10-in. plungers, all of 18-in. stroke. A 1,500,000-gall. comp., cond., Deane pump has been connected with works. Pumping station about 2,300 ft. from pond; centers of pumps on level of high-water mark of pond.

Force Main.—See Stand-Pipe.

Stand-Pipe.—Cap., 706,860 galls.; tank of boiler iron, 40 ft. in diam., 75 ft. high; set on solid masonry foundation having chambers to give access to inlet and outlet pipes. Built by Cunningham Iron Works, Boston. Connected with pumping engine by 6,500 ft. of 12-in. cast-iron pipe, which passes through several streets and connects with distributing mains for South Weymouth, the stand-pipe thus storing surplus for reserve supply. Main enters stand-pipe at center of bottom, and rises 81 ft. above bottom of tank, thus making the top of center discharge-pipe 118.9 ft. above engine-room floor and 266.4 ft. above mean high tide. Water from tank passes from bottom through another 12-in. main, and a check valve, which closes automatically when pump starts up. Force and gravity mains also have check-valve connection by means of which either stand-pipe or direct pressure can be added to gravity system.

Distribution.—*Mains*, c. i., w. l., 45⅝ miles. Pipe from A. H. McNeal, Burlington, N. J. *Services*, w. i. *Taps*, 1,457. *Meters*, 2. *Hydrants*, Chapman, 308. *Valves*, Chapman.

Consumption, about 1,000,000 galls. *Pressure*, not given.

Financial.—Cost, $361,554. Bonded debt, $344,000. Int., 4%. Sinking fund, $12,000. Ann. op. exp., $6,000. Ann. rev.: consumers, $17,000; city, $7,800 for hydrants and fountains. Hydrant rental, $24.

Management.—Five Comrs., Chn., A. J. Richards. Treas., J. H. Stetson. Secy., Henry H. Nash. Supt., Geo. J. Ries.

WHITINSVILLE, *Worcester Co.* (Pop., est., 2,500.) Incorp. village. No sewers or electric lights.

History.—Built in '89 by Whitin Machine Co.; put in operation Oct. 15. Engr., Arthur C. Moore, Sturbridge. Labor done by the day.

Water Supply.—Springs, by gravity from reservoir. Dy. cap., dry weather, 43,000 galls.

Reservoir.—Cap., 300,000 galls.; covered; 110 ft. above village.

Distribution.—*Mains*, 8 to 4-in. i., 1.7 miles. *Services*, ¾- in. rustless i. Pipe and specials from R. D. Wood & Co., Philadelphia, Pa. *Hydrants*, Mathews, 27. *Valves*, Eddy.

Pressure, 55 lbs.

Financial.—No data.

Management.—Prest., C. W. Lasell. Agt., C. A. Taft. Treas., G. M. Whitin. Reports by A. C. Moore; dates, Aug. 1, '89, March 10, '90.

WHITMAN, *Plymouth Co.* (Pop., 3,024; est., 4,000.) Manufactures eyelets, tacks, and boots and shoes. Incorp. No sewers. Has electric lights.

History.—Built in '83-4 by town. Engr., Simpson C. Heald, Worcester. Consult. Engr., Phineas Ball, Worcester. Contrs., Patent Water & Gas Pipe Co., Jersey City, N. J.

Water Supply.—Hobart pond, filtered, pumping to stand-pipe. Pond has area of 175 acres.

Dam.—At pond, owned by Dunbar, Hobart & Co.; dam of clay, 150 ft. long, 6 ft. high. Has plank in center.

Spillway.—About 50 ft. from end, lined with plank, controlled by gates; slope, 3 ft. No discharge pipes. Built "150 years" ago.

Filter Gallery.—First section, 15x100 ft., x 14 ft. deep; second, 1½x100 ft., x1⅝ ft. deep.

Pumping Machinery.—Dy. cap., 1,250,000 galls.; Worthington.

Stand-Pipe.—Cap., 240,000 galls.; 20 x 105 ft.; from Cunningham Iron Works, Boston.

Distribution.—*Mains*, 12 to 4-in. w. i. and cem., c. i., 10¼ miles. *Services*, lead. Pipes and specials from Davis & Farnum, Waltham; laid by J. R. Miller. *Taps*, 375 *Meters*, Crown, Union, 132. *Hydrants*, Ludlow, 92 *Valves*, Ludlow.

Consumption, 100,000 galls. *Pressure*, 65 lbs.

Financial.—Cost, $82,384. Bonded debt, $75,000. Int., 4%. Sinking fund, $5,302. Ann. op. exp., $3,679 Ann. rev.: consumers, $7,425; city, $2,300 Hydrant rental, $25.

Management.—Prest. and Treas., Albert Davis. Secy. and Supt., Y. C. Gilbert.

WILLIAMSTOWN, *Berkshire Co.* (Pop., village, 984; est., 2,000.) On Hoosac river, a favorite summer resort. Has some some manufactories. Not incorp Has sewers. Electric lights built in '82.

History.—Built in '59 by Williamstown Aqueduct Co. In '88 a new Aqueduct Co. built works and bought old works.

Water Supply.—*Old:* spring, by gravity. Spring at base of high hill, 30 ft. above and 1¼ miles from village. *New:* source not given; by gravity from new reservoir.

Reservoirs.—Cap., not given. *Old:* 41x67. ft., depth, not given. *New:* cap., about 280,000 galls.; 200 ft. sq., 10 ft. deep; 100 to 150 ft. above town.

Distribution.—*Mains*, c. i., 3 miles. *Services*, w. i. *Taps*, 100. *Meters*, none. *Hydrants*, 6.

Financial.—Cost, about $45,000; $30,000 for new works. Cap. stock, $50,000 consolidated. No debt. Ann. op. exp., $150. Ann. rev.: consumers, $1,000; city, none. Hydrant rental not determined at time of report.

Management.—President, A. C. Houghton. Secy. and Treas., C. M. Smith. Supt., Chas G. Sanford.

WINCHESTER, *Middlesex Co.* (Pop., 3,082; est., 4,400.) On rolling ground, 8 miles from Boston. Place of residence for Boston business men. Has tanneries. Incorp. town in '50. No sewers.

History.—Built in '73 by town. Engr., Walter H. Sears, Plymouth. Contr., Chas. Lenehan, Cambridge. Consult. Engr. for high service, M. M. Tidd, Boston.

Water Supply.—Surface water, by gravity from impounding reservior; also high-service for about 45 takers, by pumping with windmill to reservoir. Drainage area, about 460 acres.

Impounding Dam and Reservoir.—Cap., 260,000,000 galls.; area, 63 acres; elevation, 121 ft. above town. On stream. *Dam:* earth, with heart-wall; 600 ft. long, 30 ft. high, 126 ft. wide at bottom. *Heart-wall:* masonry in cement, 2½ to 1½ ft. thick. *Spillway:* 34 ft. wide. *Gate-house:* brick and stone, with 30-in. waste gate.

Discharge-pipe: 20-in. supply, reduced to 12-ins. outside dam; probably 30-in. waste-pipe. Cost of dam, $41,573.

South Reservoir.—Construction begun some time ago, but never finished. Was to cover 144 acres to depth of 37 ft. Cost to time of abandonment, $75,000, which is not included below.

Supply Main.—W. i. and cem., 12-in., 1,500 feet long.

Pumping Machinery.—Dy. cap., not given; 5-in. pump. *Windmill:* 75 ft. high, with 30-ft. wheel. *Boiler:* added in '88 or '89.

Force Main. - W. i. and cem., 6-in., 87-ft. head on pump.

High Service Reservoir.—Cap., 94,000 galls.; stone in cem., brick-lined, 40 ft. in diam., 10 ft. deep.

Distribution.—*Mains*, 12 to 2-in. w. i. and cem., about 22 miles, *Services*, w. i. and cem. Pipe furnished and laid by Geo. H. Norman, Newport, R. I. *Taps*, 847. *Meters*, 1. *Hydrants*, Boston, Newport, 83. *Valves*, Whittier.

Consumption, about 175,000 galls. *Pressure*, 45 lbs.

Financial.—Cost, $163,000, Debt, $147,000: $65,000 at 7, $55,000 at 6, and $27,000 at 4%. Ann. op. exp., about $2,000. Ann. rev.: consumers, $13,988; city, $1,200. Hydrant rental, $15. Cost of high service, $13,425.

Management.—Prest., James F. Dwinell. Secy., D. N. Spillings. Treas., Moses A. Hemick. Supt., Wm. T. Dotten.

WINTHROP, *Suffolk Co.* See Revere.

WOBURN, *Middlesex Co.* (Pop., 10,931; est., 12,760.) In hilly region containing many natural lakes and ponds. Engaged in tanning and currying leather and manufacturing electric lamps. Settled in 1640; incorp. town in 1642; city in 89; no sewers. Has electric lights.

History.—Built in '73 by town. Engr., M. M. Tidd, Boston; '88 report gave: Des. Engr., Henry M. Wightman; Const. Engr., Clemens Herschel.

Water Supply.—Ground water from filter gallery near Horn pond, by direct pumping and pumping to reservoir. Pond has area, 103 acres; depth, 20 ft.; drainage area, 7¼ sq. m.

Dam.—Not described. Cost, about, $50,000.

Filter Gallery.—Is 12x82 ft., x 5 ft. deep (av.), with side walls of dry rough stone, covered by semi-circular brick arch. No cleaning. There is pipe connection, with pond, but it has never been necessary to use it.

Pumping Machinery.—Dy. cap., 4,000,000 galls.; Worthington Blake formerly in use.

Force Main.—Diam., 14 ins.; length, 1,000 ft.; head on pumps, 90 lbs.

Reservoir.—Cap., 6,000,000 galls.; 27 ft. deep, 160 ft. above town, 220 ft. above pumps. On Horn Pond Mt.

Distribution.—*Mains*, 16 to 4-in. w. i. and cem., 42⅛ miles. *Services*, w. i. and cem., enam. i. *Taps*, 4,499. *Meters*, 37. *Hydrants*, Chapman, Pattee & Draper, Whittier, 305. *Valves*, kind, do.

Consumption, 755,072 galls. *Pressure*, 75 lbs.

Financial.—Cost, $569,182. Debt, $457,800: $400,000 at 6, $4,000 at 5, $24,800 at 4½, $15,000 at 4, $14,000 at 3½%. Sinking fund, $156,300. Ann. op. exp. (10 months), $9,985. Ann rev. (10 months): consumers, $26,937; city, $7,450. Hydrant rental, $25.

Management.—Three Comrs. Chn., Jas. T. Freeman. Registrar and Clerk, Albert P. Barrett. Supt., P. F. Crilly.

WORCESTER, *Worcester Co.* (Pop., 58,291; est., 79,547.) On branch of Blackstone river, which affords a valuable water-power at this point. On uneven ground. Has various and extensive manufactories. Settled in 1675 and 1713; incorp. town in 1722, city in '48. Has sewers and electric lights.

History.—First supplied in 1798 by Dan'l Gooding, under a State charter, supply being from springs for domestic and fire purposes. In '45 Worcester Aqueduct Co. was incorp., taking supply from Bell pond, 201 ft. above the town, and receiving $500 a year from city. Pop. was then 11,556. In '52 these works were bought by city.

Besides above there were 3 other systems of supply in '64-5 when city built present works, pop. being 28,000. Des. Engr., Phineas Ball, Worcester.

Water Supply.—Impounding reservoirs in Leicester and Holden, by gravity. Latter reservoir is on Lynde brook and was constructed by building Lynde brook dam in connection with new supply introduced in '64. Brook has drainage area of 3 sq. m.

Lynde Brook Dam and Reservoir.—Cap., 750,000 galls. For description of dam, its giving way in '76, and rebuilding, see MANUAL for '88, pp. 68-9.

Holden Dam and Reservoir.—Cap., 450,000,000 galls.; area flooded, 94½ acres. No further data.

Distributing Reservoirs.—Combined cap., over 5,500,000 galls. *Hunt:* cap., about 3,000,000 galls.; supplied from Lynde brook reservoir through pipe which discharges vertically with fall of 10 to 12 ft. *Holden:* cap., 2,500,000 galls.; on same stream as Holden storage reservoir, water flowing in natural bed of brook. *Bell Pond:* cap., not given. Supplied from Lynde brook reservoir; has small drainage area.

Distribution.—*Mains*, 20 to 4-in. c. i., w. i. and cem., 115 miles. The w. i. and cem. mains are being replaced with c. i. as rapidly as possible. *Services*, w. i. and cem. *Taps*, 8,529. *Meters*, 7,354. *Hydrants*, kind not given, 964.

Consumption, est., 4,635,000 galls *Pressure:* low-service, 70 lbs.; high-service, 150 lbs.

Financial.—Cost, $1,996,892. Debt, $1,230,000. Int., 3, 3½ and 4 %. Sinking fund, "$89,000, old; $75,000, new." Ann. op. exp., $98,210, including $34,000 for replacing w. i. and cem. mains with c. i.; charged to maintenance. Ann. rev.: consumers, $131,341; city, $2,000. Hydrant rental, free.

Management.—Comrs. Registrar, Geo. E. Batchelder. Supt., John G. Brady. City Engr., Chas. A. Allen.

REFERENCES. For further details of these works and of failure of Lynde Brook Dam, see *Eng. News*, vol. III., pp. 108. 116, 125; vol. V., p. 2; vol. VIII., p. 272. Also a report "On the Failure of the Worcester Dam," made by a committee from the American Society of Civil Engineers. Trans. Am. Soc. C. E., vol. V., pp. 244-50.

Water-Works Projected with Fair Prospects of Construction.

CORDAVILLE, *Worcester Co.* See Southborough.

FAIRHAVEN, *Bristol Co.* (Pop., 2,875; est., 3,000.) On Acushnet river, one mile from New Bedford. Summer resort. Has tack and iron works.

Proposed Works.—Fairhaven Water Co. to build in '90, pumping from wells near Mattapoisett river to stand-pipe, about 20 x 75 ft. About 14 miles 10 to 6-in. c. i. pipe and 100 hydrants. Authorized stock and bonds, $125,000 each. Hydrant rental, 20 years' contract, $50 each. Engr., O. G. Stanley, 113 Devonshire St., Boston. Prest., Jas. K. Nye, New Bedford. First designed to build in '88. Reports by O. G. Stanley; dates, July 25 and Sept. 18, '89.

FAYVILLE, *Worcester Co.* See Southborough.

FOXBOROUGH, *Norfolk Co.* (Pop., town, 2,950; est., 3,000.) Is 13 miles from Taunton. Manufactures straw goods and packing-boxes.

Proposed Works.—Foxborough Water Supply District proposes to build in '90, pumping from wells near Neponset river, to stand-pipe. Est. cost, $75,000; district to be bonded. Engr., Frank L. Fuller, Boston. Chn. Comrs., E. P. Carpenter. Report from F. D. Williams, Comr.; date, Feb. 28, '90.

HOLLISTON, *Middlesex Co.* (Pop., est., 3,000.) Manufactures boots, shoes, straw and woollen goods and nails.

Proposed Works.—Supply from lake or driven wells, pumping to stand-pipe. Cost and by whom to be built, uncertain. Address Jno. D. Shippee or Geo. B. Fiske. Report by latter; dates, July 30 and Nov. 27, '89.

MILTON, *Norfolk Co.* (Pop., to be supplied, est., 1,500.) A place of residence for Boston business men, in a farming country, 6 miles from that city.

Proposed Works.—Milton Water Co. soliciting subscriptions to stock, Mar. 1, '90. Supply, probably, from Quincy Water Co.'s works. Project started in '88. Prest., E. D. Wodsworth. Treas., Saml. Tannett. Clerk, H. E. Ware. Report by former.

NEEDHAM, *Norfolk Co.* (Pop., est., 2,800.) Has hosiery and other manufactories.

Proposed Works.—Fall of '89, town voted to build works. Comrs. appointed Dec. 3, '89. In '88 project was to pump from Charles river or Rosemary brook, probably to stand-pipe, at est. cost of $50,000. Address Water Comrs.

NORTH BROOKFIELD, *Worcester Co.* (Pop., town, 4,459.) Has manufactories.

Proposed Works.—Legislature has authorized town to build, but probably no action will be taken before '91. Latest report, by Geo. R. Hammatt, Town Clerk; date, about Mar. 1, '90. Few feet of main in use for fire protection.

PROVINCETOWN, *Barnstable Co.* (Pop., town, 4,346.) Engaged in fisheries and ship-building.

Proposed Works.—Legislature of '89 authorized town to build works costing $65,000. Preliminary surveys made prior to Oct., '89, by Percy M. Blake, Hyde Park. Supply, driven wells, pumping to stand-pipe. Annual meeting in Feb., '90, passed without town taking action. Latest report by Seth Smith, Town Clerk; date, Feb. 28, '90.

READING, *Middlesex Co.* (Pop., town, 3,181, est., 3,700.) Is 12 miles north of Boston. Manufactures shoes and rubber goods.

Proposed Works.—In '89 town accepted charter from Legislature and in Nov. appointed 3 Comrs. Preliminary observations for supply have been made by M. M. Tidd, Boston. Supply, probably, driven wells, pumping to stand-pipe. Est. cost, $100,000. Chn. Comrs., L. M. Bancroft. Report by Henry G. Kittredge; date, Nov. 26, '89.

SOUTHBOROUGH, *Worcester Co.* (Pop., town, 2,114.) Town comprises villages of Southborough, Fayville, Southville and Cordaville. Engaged in shoe manufacturing, farming and dairying.

Proposed Works.—Feb. 17, '90, Com. on Water Supply, in conjunction with its Engr., Frank L. Fuller, Boston, reported on works for Southborough and Fayville, with possible extension to Cordaville and Southville. (All villages within town of Southborough.) Supply, surface well near Stony brook, pumping to stand-pipe. Cost: est. No. 1, Southborough and Fayville, including 5.74 miles 12 to 6-in. pipe, $71,158; extension to Cordaville and Southville, including 4.61 miles 10 to 4-in pipe, $32,140. Est. No. 2, Southborough and Fayville, including 5.86 miles 10 to 4-in. pipe, $56,332. In both estimates no allowance for land has been made. Address A. D. Howe, or J. H. Robinson, members of Com., or Frank L. Fuller, Engr., 12 Pearl St. Boston.

SOUTHVILLE, *Worcester Co.* See Southborough.

Water-Works Projects Reported in '89 and '90, but Now Indefinite.

Barre, Worcester Co. *Monson,* Hampden Co.; see MANUAL for '88, p. 70. *Winchendon,* Worcester Co.; see MANUAL for '88, p. 70.

RHODE ISLAND.

Water-Works Completed or in Process of Construction.

ASHTON, *Providence Co.* See Pawtucket.

BARRINGTON, *Bristol Co.* (Pop., 1,359; est., 1,400.)

History.—Built in '87 by Barrington Water Co., for domestic supply. Originally built to supply Nayatt Point, and still does so. Engr. and Contr., Geo. H. Norman, Newport.

Water Supply.—Bristol & Warren Water-Works Co.'s system.

Distribution.—*Mains,* w. i. and cem., 3 miles. *Services,* c. i. *Taps,* 30. *Meters,* 30.

Consumption, not given. *Pressure,* 50 lbs.

Financial.—Cost, $15,000. No debt. Ann. op. exp., withheld, est., $500. Ann. rev.: consumers, withheld, est., $1,200.

Management.—Prest., Henry J. Steers. Treas., C. H. Merriman.

NOTE.—Inquiries in '89 have been ignored; above mostly from '88 MANUAL.

BERKELEY, *Providence Co.* See Pawtucket.

BLOCK ISLAND, *Newport Co.* (Pop., est., 1,300.) Summer resort on an island 20 miles at sea. No sewerage or electric lights.

History.—Built in '88 by Block Island Water Co. Engr. and Contr., J. A. Hoar, Newport.

Water Supply.—Pond, pumping to stand-pipe.

Distribution.—*Mains*, c. i., 1½ miles. *Services*, not given. *Taps*, 35. *Meters*, none. *Hydrants*, 6.

Financial.—Cost, $12,000. Ann. op. exp., $150. Ann. rev.: consumers, $794; city, $180. Hydrant rental, $30.

Management.—Prest., E. S. Payne.

BRISTOL and WARREN, *Bristol Co.* (Pop.: Bristol, 6,028; est., 5,800. Warren, 4,007; est., 4,050.) On Narragansett bay, 15 and 10 miles, respectively, from Providence. Engaged in gardening, boat-building and commerce, and manufacturing rubber and cotton goods. Each incorp. town, former in 1747.

History.—Built in '82 by Bristol & Warren Water-Works Co., whose system includes Warren and supplies Barrington and Nayatt Point, a summer resort. Engr. G. Norman Weaver, Newport. Contr., G. H. Norman, Newport.

Water Supply.—Kickenmit river, pumping to tank.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Knowles. *Boiler:* from A. Russell & Son, Newburyport, Mass.

Tank.—Cap., 329,000 galls.; 40 x 35 ft. high; from Cunningham Iron Works, Boston.

Distribution.—*Mains*, c. i., 22 miles. *Services*, w. l. *Taps*, 574. *Meters*, 5. *Hydrants*, Chapman, 208. *Valves*, Chapman.

Consumption, 450,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 80 lbs.

Financial.—Cost, $250,000. Cap. stock, $250,000. No bonded debt. Ann. op. exp., withheld, est., $4,500. Ann. rev.: consumers, $10,000; Bristol, $2,000 and Warren $3,000 for hydrant rental.

Management.—Prest., I. F. Williams. Treas., G. Norman Weaver, Newport. Secy., Sydney Deane. Supt., Benj. B. Martin.

NOTE.—Above from '88 MANUAL, which Co say is "substantially correct for '89."

CENTRAL FALLS, *Providence Co.* (Pop., 13,765; est., 15,000.) In town of Lincoln, on Blackstone river, one mile from Pawtucket and five from Providence Manufactures thread, hair-cloth, machinery and cotton and woolen goods.

History.—Distribution, only, built in '79 by fire district.

Water Supply.—Pawtucket water-works.

Distribution.—*Mains*, iron, 11¼ miles. *Services*, w. i. *Taps*, 800. *Meters* Crown, 70c. *Hydrants*, Falcs & Jenks, 80.

Consumption, unknown. *Pressure*, 100 lbs.

Financial.—Cost, $70,000. Debt (in '86), $37,500. Int., 5%. Ann. op. exp. (in '86), $3,000. For further data see Pawtucket; also see Management, below.

Management.—Fire district operates works, and officers of Pawtucket water-works collect rents and give Central Falls rebate of 40%.

CRANSTON, *Providence Co.* See Providence.

DROWNVILLE, *Bristol Co.* (Pop., est., 400.) In town of Barrington. No sewers or electric lights.

History.—Built in '87 by Drownville Water Co., for domestic supply.

Water Supply.—Well and pond, pumping to tank. Well is 10 ft. in diam.

Pumping Machinery.—Cap., not given; two Gould; one 3½x10-in., one 3x7-in.; also dup., Worthington pump at creamery as auxiliary. *Windmill:* not described. Windmill and Gould pumps from Most, Foos & Co., Boston.

Tank.—Cap., 52,000 galls.; 16x24 ft.; from Most, Foos & Co., Boston.

Distribution.—*Mains*, Wyckoff, 2½ miles. *Services*, lead. Pipe from Ayrault Bros., Tonawanda, N. Y. *Taps*, 33. *Meters*, Union, 15.

Consumption, 6,000 galls. *Pressure*, 40 lbs.

Financial.—Cost, $8,000. Cap. stock, $7,500. No bonds. Debt, $500. Int., 5½%. Ann. op. exp., $200. Ann. rev.: consumers, est., $500; city, $75.

Management.—Prest., David A. Waldron. Treas., Geo. T. Baker. Secy. and Supt., C. F. Anthony.

EAST GREENWICH, *Kent Co.* (Pop., 2,877; est., 5,000.) On Narragansett bay, 13 miles from Providence. Has bleaching works and cotton and woolen manufactories. No sewers. Has electric lights.

History.—Built in '86 by East Greenwich Water Supply Co. Engr., A. W. Forbes, Boston.

Water Supply.—Hunt's river, pumping to stand-pipe.

Pumping Machinery.—Cap., 1,000,000 galls.; Worthington. *Boiler:* Whittier.

Stand-Pipe.—Cap., 160,000 galls.: from Cunningham Iron Works, Boston.

Distribution.—*Mains*, c. i., 9 miles. *Services*, w. i. Pipe and specials from R. D. Wood & Co., Philadelphia, Pa.; laid by Ferris & Halladay, Jersey City, N. J. *Taps*, 230. *Meters*, 15. *Hydrants*, Mathews, 53. *Valves*, kind, do.

Consumption, 160,000 galls. *Pressure:* Ordinary, 50 lbs. Fire, 200 lbs.

Financial.—Cost, $100,000. Cap. stock, $75,000. Bonded debt, $73,000. Int., 5%. Ann. op. exp., $5,700. Ann. rev.: consumers, $6,650; city, $1,500. Hydrant rental, $28½. Rev. from consumers in '87, $8,000.

Management.—Prest., James H. Eldridge. Secy. and Treas., S. M. Knowles. Supt., J. L. Congdon.

EAST PROVIDENCE, *Providence Co.* (Pop., 5,056; est., 6,000.) On Providence river, about 1 mile from Providence. Engaged in manufacturing and oyster trade.

History.—Built in '80 by town. Engr., C. H. M. Blake. Contr., J. J. Newman, Providence. After the original plant was completed the distribution system was turned over to the Pawtucket water-works, which pays a rebate of 25% on all rates collected. All other data included under Pawtucket.

FISKEVILLE, *Providence Co.* See Phenix.

HOPE, *Providence Co.* See Phenix.

JOHNSTON, *Providence Co.* See Providence.

LONSDALE, *Providence Co.* See Pawtucket.

NARRAGANSETT PIER, *Washington Co.* See Wakefield.

NAYATT POINT, *Bristol Co.* See Barrington.

NEWPORT, *Newport Co.* (Pop., 15,693; est., 22,000, largely increased by summer visitors.) On Narragansett bay, on summit and slopes of a hill, Has good harbor, considerable commerce, and is a famous watering place. Settled in 1639; incorp. a city in 1784. Has sewers and electric lights.

History.—Built in '76-7 by Geo. H. Norman, Newport, under 50-years franchise, and owned by him till June, '81, when Co. was organized and took possession of the works. Des. Engr., Geo. H. Norman. Const. Engr., G. Norman Weaver. Most of work was done by original owner.

Water Supply.—Easton's and Paradise ponds, filtered, pumping to reservoir from two stations, that at first pond being one,and at second, 3 miles from city. Eastons' pond was formed by impounding the water of 4½ sq. m. drainage area by two dams flooding 160 acres.

Dams.—Sand, one 2,800 ft. long, 15 ft. high and 16 ft. wide on top, with water slope covered with riprap; other 2,000 ft. long, 20 ft. high and 16 ft. wide on top.

Pumping Machinery.—Combined dy. cap., 7,000,000 galls.; Knowles, of 19½-in. water cylinder and 36-in. stroke, Carr-Selden of 12-in. water cylinder and 24-in. stroke, Knowles high-pressure, and 3,000,000-gall., Curtis pump. Lift from first pumping station is 160 ft.

Filter.—Dy. cap., 6,000,000 galls.; Hyatt; erected in '83.

Distributing Reservoir.—Cap., 10,000,000 galls.; flow-line is 60 ft. above highest point in city.

Distribution.—*Mains*, 24 to 4-in. c. i., w. i. and cem., 50 miles; 12 miles laid by Inman Bros., New York City. *Services*, w. i. and cem. *Taps*, 2,500. *Meters*, Crown, Worthington, 12. *Hydrants*, kind not given, 220.

Consumption, 1,000,000 galls. *Pressure*, 55 lbs.

Financial.—Cost, $700,000. Cap. stock, $750,000. No debt. Ann. op. exp., $20,000. Ann. rev.: consumers, $60,000, city, $10,000.

Management.—Prest., Geo. H. Norman. Secy., R. S. Franklin. Treas. and Supt., Wm. S. Slocum.

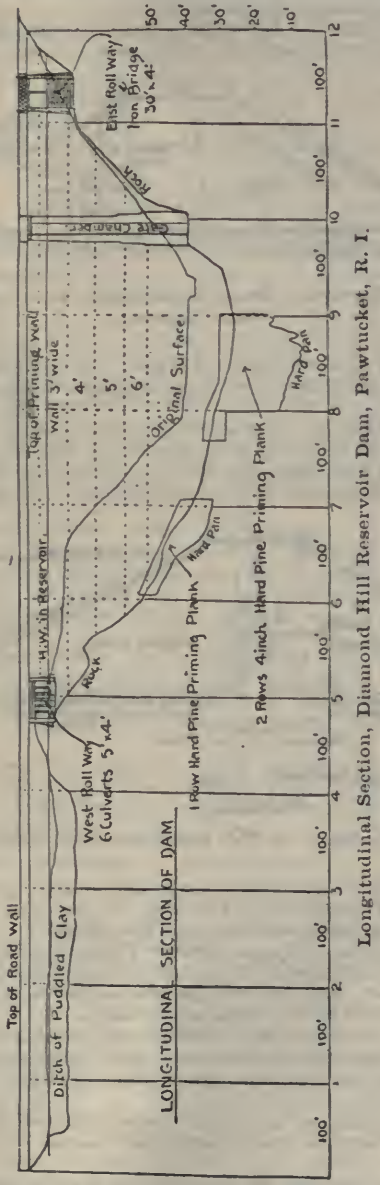
NOTE.—With one or two corrections above data is that given for and in '88 MANUAL, no later figures having been furnished in response to inquiries.

OLNEYVILLE, *Providence Co.* (Pop., 5,765.) See Providence.

PAWTUCKET, *Providence Co.* (Pop., 19,030; est. pop. supplied, 40,000.) On Pawtucket river, 4 miles from Providence. Engaged in manufacturing. Incorp., town in '28, city in '85. Has sewers and electric lights.

History.—Built in '77-9 by city. Walter H. Sears was Engr., '77-8, after which Edwin Darling, the present Supt., took charge. N. Henry Crafts, Boston, Mass., was consult. engr. in '76-7. In '79 Central Falls fire district was first supplied, it having built a distributing plant that year. In '80, Watchemoket fire district was supplied, and in '8 Lonsdale and Valley Falls division was built by Pawtucket. In '81

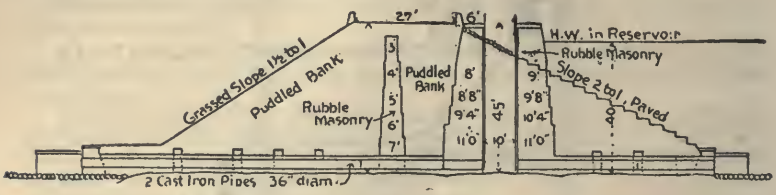
Berkeley and Ashton division was added. Works are operated in five divisions, and a separate account is kept for each; Divisions are given below, and to show relative size of each, total rev. from each for '88 is given: Pawtucket, $59,573; Lonsdale and Valley Falls, $14,714; E. Providence, $6,417; Central Falls, $12,793; Ashton (in-


Longitudinal Section, Diamond Hill Reservoir Dam, Pawtucket, R. I.
LONGITUDINAL SECTION OF DAM
Top of Road wall
Ditch of Puddled Clay
West Roll Way 6 Culverts 5'x4'
1 Row Hard Pine Priming Plank
2 Rows 4inch. Hard Pine Priming Plank
Hard Pan
Original Surface
Top of Priming wall
Wall 3' wide
H.W. in Reservoir
East Roll Way Iron Bridge 30'x4'
Gate Chamber
Rock
50' 40' 30' 20' 10'
100'

cludes Berkeley), $416; total, $93, 919, of which $34,310, or about 37% is from consumers outside Pawtucket. As E. Providence built its works but no longer operates them, it receives a rebate of 25% of receipts from consumers; Central Falls still owns and operates its distributing plant, and receives a rebate of 40% of receipts from consumers.

Water Supply.—Abbott's run, filtered, pumping to reservoir through distributing mains. Water is impounded by a dam forming Happy Hollow pond, at the source of supply, while further up the stream a dam forms a storage reservoir known as the Diamond Hill. Water passes from this reservoir through the natural stream. Abbott's run has drainage area of 26 sq. m.

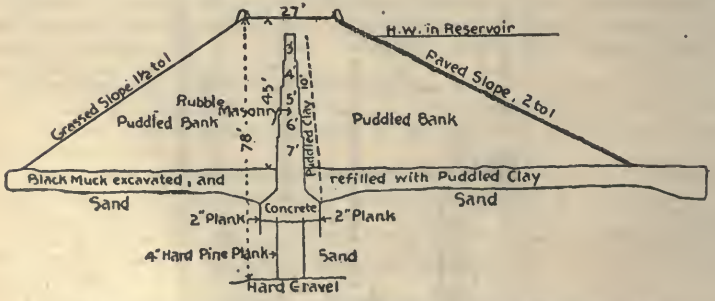
Diamond Hill Dam and Reservior.—Cap., 1,600,000,000 galls.; area, not given Dam of puddled earth, with heart-wall; 1,050 ft. long, 45 ft. high at highest point, 27



Diamond Hill Reservoir Dam, Pawtucket, R. I.—Section through Gate-Chamber.

ft. wide on top. High water 6 ft. below top of dam. Top used for driveway. Soil beneath dam was black muck, and was removed to depth of several feet and replaced with puddled clay.

Spillways: two, masonry, one at each end of highest part of dam; that at east end, 30 ft. long, 6 ft. high, with iron bridge across it; at west end, 6 openings, or culverts, 5 ft. wide by 4 feet high, with 2 ft. of stone between. *Gate-house:* granite masonry, 10 ft. sq., surmounted by handsome building. *Discharge-pipes:* two, 36-



Cross-Sectoin, Diamond Hill Reservoir Dam, Pawtucket, R. I.

in., with 2 cut-off walls on inner and 4 on outer side of dam. See accompanying sections for further data. Completed and filled Feb., '88. Engr., Geo. C. Tingley. Work done under direction of Edwin Darling, Supt. Cost, $95,887.

Dam and Reservoir at Happy Hollow Pond.—Cap. 72,000,000 galls.; area flooded. 23 acres. Dam originally of wood, 75 ft. long, 9 ft. high. This dam was carried away by flood, Feb. 14-16, '86, and afterwards rebuilt, either of wood or stone, on curve, with overflow extending entire length.

Supply Mains.—First was 30-in., 3,696 ft. long, leading to station No 1. A 36-in. main supplies station No. 3, and the new filter. Arrangements are made for supplying each of the stations with filtered water from the new filter, or directly from reservoir.

Filters.—*Old:* dimensions not given; upward filtration through gravel and sand; designed to remove fish spawn and inorganic matter of comparatively large size.

New: Area, 2,060 sq. ft.; 20 x 102 ft., with 6 ft. of filtering material; upward filtration; 1½ ft stone, largest being 2 ins. in diam., 1 ft. birch and maple charcoal, 1½ ft. pebbles, graded to pea gravel at top. Bed rests on iron grating of 3 x 5-16-in. iron bars on edge, with 1½ ins. space between each bar. Bars rest on 7-in. rolled iron beams, 5¼ ft. apart; these last rest on brick piers. A substantial masonry wall surrounds the whole. When in full operation there is 5 ft. of water at top of bed. A 36-

in. supply pipe admits water beneath bed through gate-well. Overflow passes to wells, thence by 30-in. pipes to pump wells in adjoining station No. 3, or to either of other stations.

Filter washed by shutting off supply, and opening drains below, which reverses the flow. After water is all out hose is attached to a pipe running the length of the gallery, and water at a pressure of about 40 lbs. played upon the top of bed. This is continued till gravel will not soil the hands. As high as 10,000,000 galls. a day sometimes pass filter, or 3.4 galls. per minute per sq. ft. Built in '88. Cost, $5,000. Cost of charcoal alone, $500. Filter may be cleaned as often as is desired without extra cost as it is done by regular employés.

Pumping Machinery.—Dy. cap., 12,000,000 galls.; Corliss; 3,000,000 pumps at stations 1 and 2, nd 6,000,000 at No. 3. Pump at No. 1 has been run continually since '79, and in '88 made an average daily duty of 124,512,184 ft. lbs. At No. 2 both steam and water-power are used. This station was built in '84; station at No. 3 was added in '88, and has provision for two more 6,000,000-gall. pumps.

Force Main.—Diam., 24 ins.; length, 11,000 ft.; head, 269 ft.

Distributing Reservoir.—Cap., 20,000,000 galls.; in excavation and embankment, circular; area, 3 acres; depth, 21 ft. Banks 35 ft. wide on top, founded on rock; dry masonry retaining wall on inner side, founded on concrete and backed by same about two-thirds of its height. Bottom covered with 1 ft. of concrete, connected with concrete foundation of retaining wall. Outer slopes, 1½ to 1. Reservoir stores excess of pumping above consumption, and gives out when pumping is less than consumption, flow being regulated by valve. *Gate-chamber:* masonry, 11 ft. square, with 3 gates, each 3 ft. sq., for drawing water for outflow at different depths.

Distribution.—*Mains*, c. i., 106 miles; 21 miles laid by Inman Bros., New York City. *Services*, tarred w. i. *Taps*, 5,109. *Meters*, 3,098; mostly Crown and Union, with a few Desper, Worthington, Ball & Fitts, Duplex, Equitable and Empire. *Hydrants*, Fales & Jenks, 800. *Valves*, Chapman.

Consumption, 4,258,187 galls. *Pressure*, 65 to 130 lbs.

Financial.—Cost, $1,477,705. Debt, $1,477,705: $500,000 at 5, $600,000 at 4, $377,705, notes, at 4%. Sinking fund, $240,000. Ann. op. exp., $26,051. Taxes, $1,434. Ann. int., $56,200. Rebates, $6,752. Ann. rev.: consumers, $79,267; misc., $1,422; stock sold and labor performed, $6,727; cities, $13,230. Hydrant rental, av., $15. Cost to Apr., '80, $668,071. Op. exp., Apr. 1, '80 to Apr. 1, '81, $8,497. Rev., Apr. 1, '79, to Apr. 1, '80, $23,396. Total rev., Oct. 1, '78 to Dec. 1, '88, $627,451. Total maintenance, $183,941; int., $38,692; rebates, $29,818; paid to sinking fund, $22,000, which is excess of rev. above op exp. and int.

Management.—Three Comrs. Prest. L. B. Darling. Secy. and Supt., Edwin Darling.

References.—General description of works, *Eng. News*, Vol. xxi., pp. 493-4; also Tenth Census U. S., Vol. XVII., Water Supply of Cities, pp. 165-7. Illustrations showing details of Diamond Hill Reservoir dam are given in Annual Report of R. I. Comr. of Dams and Reservoirs for 1885.

PAWTUXET, *Providence Co.* See Providence.

PEACE DALE, *Washington Co.* See Wakefield.

PHENIX, *Kent Co.* (Pop., 1,033; est., 1,000; est. pop. supplied, not given.) On Pawtuxet river, 10 miles west of Providence.

History.—Built in '85-7 by Pawtuxet Valley Water Co. Engr., H. B. Barton, Centreville. Contrs., Leach & Baldwin, Philadelphia, Pa.

Supplies Hope, Fiskeville, Arkwright, Phenix, Clyde, River Point and Lippitt, all in Pawtuxet Valley. Extended to River Point in '88-9.

Water Supply.—Spring Lake Brook, by gravity from impounding reservoir.

Spring Lake Impounding Dam.—Cap., about 37,000,000 galls.; area flooded, 18 acres; depth of water, about 14 ft. Dam of clay and gravel, in layers, puddled, with retaining wall on lower side and heart-wall; 925 ft. long, 17¾ ft. high, 10 ft. wide on top, 36 at bottom, with water within about 3 ft. of top; inner slope paved; loose earth beneath dam was removed. *Retaining-wall:* stone, 6 ft. thick at bottom, 4 at top, which comes within 3 ft. of top of dam; carried below bottom of dam, with foundation extending each side. *Heart-wall:* concrete, 2 ft. thick, carried within 3 ft of top, and some distance below bottom of dam; 3 ft. from retaining wall. *Spill-way:* at extreme end of dam, in earth, lined with masonry, free; about 50 ft. wide by 3 ft. deep at overfall. *Waste-pipe:* 16-in.; slope, ½ in. to 1 ft.; enclosed in masonry wall throughout entire length.

Built in '87. Engr., Herbert B. Barton, Centerville. Original Contrs., Jacoby & Madden, who abandoned the work before completion; finished by H. B. Leach, Philadelphia. Cost, $12,000.

Dam gave way Aug. 25, '89, probably owing to undermining at original bed of river. Gap left was between 60 and 70 ft. long, just above waste-pipe. There was evidently a spring near waste-pipe, as dam has leaked considerably at this point ever since it was completed. Three lives were lost by the break, and about $25,000 (est.) damage done. Damage to dam (est.), $3,000. Repairs were made with —— Temple, Providence, as Engr.; work done by the day, with Jos. H. Congdon in charge.

Distribution.—*Mains*, c. i., 12 miles. *Services*, lead. Pipe from Warren Foundry & Machine Co., Phillipsburgh, N. J. Specials from Fuller Iron Works, Providence, R. I. *Taps*, 132. *Meters*, Crown, 19. *Hydrants*, Ludlow, 112. *Valves*, Ludlow.

Consumption, not given. *Pressure*, 80 lbs.

Financial.—Cost, $100,000. Cap. stock, $100,000. Bonded debt, $50,000. Int., 5%. Ann. op. exp., withheld, est., $2,000. Ann. rev.: consumers, withheld, est., $5,000; city, $1,200. Hydrant rental, $30.

Management.—Secy., Vernum A. Bailey. Supt., Albert F. Hill.

PROVIDENCE, *Providence Co.* (Pop., 104,857; est., 125,000.) At head of navigation on Narragansett bay, 35 miles from ocean. Two small rivers meet in center of city and on east is Blackstone river, which near its mouth becomes a tidal basin called Seekonk river. Confluence of these 3 rivers forms Providence river. Business part of city is near river and about 10 ft. above tide-level; a second part rises on each side of river 75 ft. above tide-level, while a small section is at an elevation of from 90 to 200 ft. Engaged largely in commerce and manufacturing. Settled in 1636; incorp. a city in '32. Has sewers and electric lights.

FIRST SUPPLY.

Introduced in 1772 by Co., who distributed spring water through ¾ miles of wooden logs. In the same year "Rawson's Fountain Society" collected spring water in a reservoir 13½ x 30 ft., 10 ft. deep, from which water was conveyed through 6,600 ft. of 4-in. wooden logs. Providence Water Co. also built two fountains or small reservoirs. From these water was supplied to families for $10 each.

PRESENT WORKS.

History.—Built in '70-6 by city; water first introduced in '71. Engr., J. Herbert Shedd, Providence. City also supplies other parts of Cranston, and those parts of Johnston and North Providence within one mile of city limits, and village of Pawtucket. Terms are same as for Providence. Johnston supply introduced in '73, Olneyville in '75, Cranston in '76, Pawtuxet in '80.

Water Supply. - Pawtuxet river, pumping to Sockanosset storage reservoir, thence by gravity to low service mains and Hope storage reservoir, and by pumping from latter to Fruit Hill high service reservoir. Until '89 high service was by direct pumping from Hope reservoir. River above point of supply has drainage area of 192 sq. m., depth of 15 to 20 ft., velocity of about one mile per hour; principal part of bed, gravel and sand. Water taken from river 6 miles from heart of city.

Intakes.—Two; 24-in. pipe, 700 ft. long, connecting with Worthington pump, and 36-in. pipe leading to settling basin.

Old Filter Bed.—Excavated near river to considerable depth. Soil not as porous as expected, so bed not successful.

Settling Basin.—Not described. Supplies two of the pumps.

Low Service Pumping Machinery.—Dy. cap., 23,000,000 galls.: Worthington Cornish and Corliss, all at Pettaconset pumping station, but each in a separate building. *Worthington:* 5,000,000-gall. dup.; 20-in. high-, 36-in. low-pressure steam cylinders, 22-in. water plungers; av. stroke, 47 ins. Works under 175-ft. head; erected in '71. *Cornish:* 9,000,000 gall.; 100-in. steam cylinder, 39-in. pump plunger; av. stroke, 130 ins.; erected in '76. *Corliss:* 9,000,000-gall. comp.; 18-in. high-, 36-in. low-pressure steam cylinders, 19-in. pump plunger; av. stroke of plungers, 36 ins.; diam. of fly-wheel, 25 ft.; erected in '81-2.

Stand-Pipe.—Not stated whether now in use. Regulator of pressure, in building with Cornish pump; boiler, i.; inner shell 5½ ft. in diam. by 184 ft. high, thickness not given; outer, 8 ft. in diam., 189 ft. high, ½ in. thick for 54, ¾ ins. for 56 and ¼ in. for 79 ft. Four 42-in. inlets (only one used), and three 36-in. outlets, two of which are used.

Force Mains.—Two, each 36 ins. in diam., 5,042 ft. long, ending in Sockanosset reservoir.

Sockanosset Reservoir.—Cap., 50,054,000 galls.; area of bottom, 9.54 acres; of high-water surface, 10.95 acres; elevation, 180½ ft. above mean high tide in Providence river, and 156 ft. above pumping station. In embankment, with heart-wall; pear-shaped, about 890 x 1,000 ft. at base, banks 19 ft. high above bottom of reservoir, 15 ft. wide on top. Inner and outer slopes, 1½ to 1, inner covered with 8 ins. of broken stone, or concrete, and 12-in. stone paving to within 1 ft. of top. High-water, 4 ft. below top of bank. Bottom covered with concrete. *Heart-wall:* puddle, 8 ft. thick at level of reservoir bottom, 4 ft. thick at top, which is about 2 ft. below top of bank; wall carried about 2 ft. below bottom of reservoir, toothed. From bottom of inner face of wall to foot of inner slope, layer of puddle, 2 ft. thick, is carried.

Outlet and Inlet Chambers, and Connecting Conduit: outlet in northern and inlet in southern bank, connected with 4-ft. brick conduit, about 900 ft. long, laid in embankment, around reservoir, to supply city directly from pumps, if desired. Each chamber has 3 cells, one for influent, one for effluent pipe, third providing for future pipe. Inlet-chambers admit water at bottom, outlet draw from near top of reservoir.

Supply Mains.—Two, each 29,538 ft. long, 30 ins. in diam. till in center of city, when they are reduced to 24 ins.; one diminishes at Mathewson St, crosses river under Exchange Pl. on iron piles and terminates at Hope reservoir and high service station; other diminishes at Dorrance st., crosses under Great bridge on iron piles, and at Waterman St. is connected with Hope reservoir with 30-in. main.

Hope Reservoir.—Cap., 75,677,000 galls.; area at bottom, 10.6 acres, at high-water, 12.6 acres; elevation, 162½ ft. above high tide in Providence river. In embankment, with heart-wall, irregular, 840 x 950 ft., with banks 21½ ft. above bottom except for some distance, where ledge rises decreasing height to 15 ft. Banks 15 ft. wide on top, with both slopes 1½ to 1, inner paved with 12 to 14-in. granite blocks, to within 1 ft. of top.

Heart-wall: like that at Sockanosset reservoir, which see.

Influent and Effluent Pipes: influent pipe discharges near center of reservoir, from two directions, passing through effluent gate-chambers at each end of reservoir, where inflow can be controlled by gates. Water can be drawn from top or bottom of reservoir.

Spillway: at northeast corner.

Original intention was to use this reservoir as regulator to low service, but as a greater head can be obtained directly from Sockanosset reservoir, Hope reservoir is now used wholly to supply high service.

High Service Pumping Machinery.—Dy. cap., 10,000,000 galls; Corliss and Nagle. *Corliss:* 5 20-in. steam cylinders, 5 12-in. pump plungers; av. stroke, 30 ins.; erected in '73. *Nagle:* comp., 11-in. high, 19-in. low-pressure steam cylinders, 17-in. pump plungers; av. stroke of latter, 48 ins.; diam. of fly-wheel, 13 ft. Built in '76 by Providence Steam Engine Co. These pumps can draw their supply directly from Sockanosset supply mains, if desired.

High Service Force Main.—Diam., 24 ins.; length, 19,500 ft.

Fruit Hill High Service Reservoir.—Cap., 25,000,000 galls.; area of bottom, 3.22 acres; high-water service, 4.58 acres. Elevation, 274¾ ft. above mean high tide, and 112¼ ft. above high-water in Hope reservoir. In embankment, 489 x 657 ft. at base, outside; 295 x 475 ft. at base, inside. Completed late in '89. Engr., Samuel E. Gray, City Engr. Cost, about $134,000.

Distribution.—*Mains*, 30 to 6-in. c. i., 210.7 miles. *Services*, lead. *Taps*, 13,643. *Meters*, 8,094. *Hydrants*, Providence, 1,305.

Consumption, 5,518,691 galls. *Pressure*, 39 to 73 lbs.

Financial.—Cost, $5,910,141. Debt, $6,243,000. Int., 3½, 5 and 6%. Sinking fund, $198,064. Ann. op. exp., $57,757. Ann. rev.: consumers, $295,323; city, $54,536. Hydrant rental, $30. Cost, to Nov. 1, '76 (time when board of construction was succeeded by board of maintenance), $4,473,009. Cost to Jan., '80, $5,084,182.

Management.—Comr. Public Works, Jno. Coleman. City Engr., Saml. M. Gray.

References.—Tenth Census U. S., Vol. XVII., Water Supply of Cities, pp. 70-77; full description of works as they were about '80, with illustrations.

"Water-Works of the City of Providence," by Wm. Aspinwall. Reprinted in pamphlet form from Providence *Daily Journal*, of Feb. 24, '74.

"General Description of Providence Water-Works." Prepared in City Engr's office; dated Dec. 31, '82.

See *Eng. News*, Vol. VIII., pp. 195-202, and Vol. XV., pp. 258, 274-6; latter fully describes distributing system and has many illustrations.

RIVER POINT, *Kent Co.* See Phenix.

VALLEY FALLS, *Providence Co.* (Pop., 1 861, est., 2000.) See Pawtucket.

WAKEFIELD, *Washington Co.* (Pop. to be supplied, est. 3.000 permanent, with 6,000 in summer.) Incorp. No sewers. Has electric lights.

History.—Built in '88-89 by Wakefield Water Co. Supplies Wakefield, Narragan sett Pier, Peace Dale and Rocky Brook. Engr., J. Herbert Shedd, Providence.

Water Supply.—Rocky brook, pumping from impounding reservoir to stand-pipe 190 ft. above tide-level. Area to be supplied is generally from 10 to 60, and at extreme points, 130 ft. above tide-level.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two 1,000,000, Worthington; a comp., cond., and regular pattern.

Reservoir.—Cap., 10,000,000 galls. No other data.

Stand-pipe.—Cap., 290,000 galls.; 30 x 55 ft.

Distribution.—(July 1, '89). *Mains*, c. i., 14 miles. *Services*, not given. *Taps*, 100. *Meters*, none. *Hydrants*, kind not given, 137.

Financial.—Cost, $165,000. Cap. stock, authorized, $150,000. Bonded debt, $150,-000. Int., 6 %. Other data not determined.

Management.—Prest., Richard Pancoast. Secy. and Treas., A. B. Richards. Both of N. Y. City. Mgr., Willard Kent, Narragansett Pier.

WARREN, *Bristol Co.* See Bristol and Warren.

WESTERLY, *Washington Co.* (Pop., 6,104; est., 9,000.) On Pawcatuck river, opposite Pawcatuck, Conn. Engaged in quarrying granite and manufacturing cotton and other goods. No sewers. Has electric lights.

FIRST WORKS.

General Description.—Built by Co. in '76. Water obtained from springs on hillside, collected in reservoir 12 x 30 ft., x 9½ ft. deep. Mains, 3 and 4-in.. about 5,000 ft. Head, 30 to 40 ft.

PRESENT WORKS.

History.—Built in '86 by Westerly Water-Works Co. Extended to Pawcatuck, Conn., in '87. Des. Engr., J. Herbert Shedd, Providence. Const. Engr.. Wm. M. Brown, Jr. Contrs., Adam Miller & Co., Saratoga, N. Y., and F. A. Snow, Providence.

Water Supply.—Shunoc brook, pumping to stand-pipe.

Pumping Machinery.—Cap., 3,000,000 galls.; two Worthington comp., cond *Boilers*, Babcock & Wilcox.

Stand-Pipe.—Cap., 11,100,000 galls.; 30 x 70 ft.; from Robinson Boiler Works, Boston.

Distribution.—*Mains*, c. i., 15 miles; 2.77 miles in Pawcatuck, Conn. *Services*, lead. Pipe from McNeal Pipe & Foundry Co., Burlington, N. J., M. J. Drummond, N. Y. City, and Gloucester Iron Works, offices, Philadelphia, Pa. *Taps*, 302. *Meters*, 150. *Hydrants*, Chapman, Ludlow, 20; 15 in Pawcatuck, Conn., and 3 private. *Valves*, kind, do.

Consumption, 175,000 galls. *Pressure*, 85 lbs.

Financial.—Cost, $140,000. Bonded debt, $100,000. Int., 5 %. Ann. op. exp.., withheld, est., $2,000. Ann. rev.: consumers, $6,500; city, $900. Hydrant rental, $40.

Management.—Prest., Jonathan Chase. Secy. and Treas., Chas. Perry, Jr. Supt., Everett Barns.

WOONSOCKET, *Providence Co.* (Pop., 16,050; est., 20,000.) On Blackstone river, 16 miles from Providence. Manufactures machinery, cotton, woolen and rubber goods. Incorp. town in '67; city, Jan 1, '89. No sewers. Has electric lights.

History.—Built in '84, now owned by city. Engr., Jno. W. Ellis. Contr., Jno. W. Rutherfoord, N. Y. City.

Water Supply.—Crook Falls brook, pumping to tank. There are two storage reservoirs on the brook.

Dams and Reservoirs on Crook Falls Brook.—Cap., not given. *Upper, or No 2:* gave way in freshet of Feb., '86. No data regarding rebuilding. See close of description of lower dam. *Lower, or No. 1:* cap., 36,000,000 galls.; area, 10¼ acres; depth at dam, 40.23 ft. Dam of earth with heart-wall; inner part, clay and gravel puddle; outer, sand puddle; original surface, gravel; length not given; 46.23 ft. high; 20 ft. wide on top; 189.75 ft. at bottom. Inner slope, 2 to 1, paved with rough, flat stone; outer, 1½ to 1. *Heart-wall:* rubble in cem.. with 8-in. concrete core; 7 ft. thick at bottom, tapering; carried 7.4 ft. below bottom, within 4.1 ft. of top. *Spillway:* about 50 ft. from west end, free; originally in earth, but washed out to rock

bottom in freshet of Feb., '86. *Discharge-pipe:* 12 in.; slope, 24 to 1. Does not leak badly. See History. Cost, $55,000. Illustrations of both dams are given in Ann. Rept. of R. I. Comr. of Dams and Reservoirs for '85, pp. 87-100.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two 1,000,000 direct-acting dup. Worthington; a comp. and a high-pressure.

Tanks.—*Old:* cap., 446,000 galls.; 50x30 ft.; from Cunningham Iron Works, Boston.

New: Cap., 520,000 galls.; 30x35 ft.; from Porter Mfg. Co., Syracuse, N. Y. Built in '89.

Distribution.—*Mains*, 14 to 4-in. c. i., 23.14 miles. *Services*, lead. Pipe and specials from R. D. Wood & Co., Philadelphia, Pa.; Pancoast & Rogers, N. Y. City; McNeal Pipe & Foundry Co., Burlington, N. J. *Taps*, 862. *Meters*, 761. *Hydrants*, Chapman, 349. *Valves*, Chapman.

Consumption, 269,528 galls. *Pressure*, 100 lbs.

Financial.—(For 8 months ending Dec. 31, '88.) Cost, $368,810. Debt, $300,000. Int., 4%. Sinking fund, $37,943. Ann. op. exp., $4,890. Int. paid, $6,000. Ann. rev.: consumers, $11,453; misc., $159; city, $9,702. Hydrant rental, $30 and $32½; purchase cost of works, Apr. 1, '85, $298,613.

Management.—Three Comrs. Supt., Byron J. Cook.

Water-Works Projected with Fair Prospects of Construction.

WARWICK and COVENTRY, *Kent Co.* (Pop.: Warwick, town, 12,164 est., 13,500. Coventry, town, 4,510.)

Proposed Works.—Warwick & Coventry Water Co., organized in June, '89, under State charter, to supply villages in above towns, including Centreville, about south branch Pawtucket river. In '89 contract was made with Warwick fire district for 53 hydrants at $30 each per year for 20 years, and with Coventry fire district for 50 hydrants at $30 each for 10 years. Works must be completed by Jan., '90. Supply, lake, by gravity. Oct. 1, '89, negotiations were being made to sell bonds and secure right of way. Prest., Jno. Arnold, Phenix. Secy. and Engr., Herbert B. Barton, Centreville, R. I. Reports by latter; dates, July 25 and Oct. 1, '89.

Water-Works Projects Reported in '89 and '90, but Now Indefinite.

Burrillville, Providence Co. *Cumberland Hill*, Providence Co. *Jamestown*, Newport Co. *Lincoln* (P. O. Central Falls), Providence Co. *N. Smithfield* (P. O. Woonsocket), Providence Co.

CONNECTICUT.

Water-Works Completed or in Process of Construction.

AMESVILLE, (*Falls Village P.O.*) *Litchfield Co.* (Pop., 377.) At head of Great Falls of Housatonic river, ½ mile from post-office of Falls Village; site of repair shops of Housatonic R. R. Co.

General Description.—A small system for supplying shops and village was built by R. R. Co. in '72. Engr., W. E. Pettee. Water obtained from spring, by gravity. Spring 170 ft. above shops, collected in a small stone basin and conducted through distributing main in village to small reservoir. There are about 50 taps and 4,500 ft. of w. i. mains. No fire hydrants. Works managed by Master Mechanic of shops. More details given in *Eng. News*, Vol. X., p 135.

ANSONIA, *New Haven Co.* (Pop., 3,855; est., 8,000.) On Naugatuck river, 10 miles from New Haven, in narrow valley between steep sand hills. Manufactures clocks, brass, copper and woolen goods. Incorp. Has sewers and electric lights.

ANSONIA WATER CO.'S PLANT.

History.—Built in '69.

Water Supply.—Surface water, by gravity. Pump in factory used for fire purposes.

Dam.—Stone, 175 ft. long, 18 ft. high, 8 ft. thick at bottom, 3½ ft. at top; curved 10 ft. toward water. Inner side filled against with earth sloping 1 to 1. Cost, about $3,500.

Pumping Machinery.—Dy. cap., 500.000 galls.; Deane.

Reservoirs.—Cap., 33,000,000 galls.; three, covering about 14 acres. First reservoir formed by a stone dam across a small stream (see above); 220 ft. above village, with cap. of 10,000,000 galls.

Distribution.—*Mains*, w. i. and cem., 8 miles. *Services*, galv. i. *Caps*, 350. *Meters*, 6. *Hydrants*, Chapman, 54. *Valves*, Chapman.

Consumption, about 275,000 galls. *Pressure:* Ordinary, 80 lbs. Fire, 120 lbs.

Financial.—Cost, $130,000. Cap. stock, $30,750. Debt, $91,300: $58,500 bonds at 5%.; $32,500 of bills payable, secured by mortgage. Ann. op. exp., $2.000. Ann. rev.: consumers, $7,800; city, $1,500. Hydrant rental, $28.

Management.—Prest., Thos. Wallace. Secy., Treas. and Supt, Dana Bartholomew.

FOUNTAIN WATER CO.'S PLANT.

History.—Built in '72; put in operation Dec. 6. Supplies West Ansonia.

Water Supply.—Springs, by gravity from reservoir.

Dam and Reservoir.—Cap., not given. Dam of stone, about 200 ft. long, 22 ft. high, 4 ft. thick at top, 18 at bottom; 25 ft. from this is a masonry wall 7 ft. thick; space between filled with earth. *Effluent:* upright pipe built in masonry at inner wall; 3 ft. in diam., 24 ft. high; has gates for drawing water from different levels. Supply main connects with this pipe at bottom. A 12-in. waste-gate provides for drawing water from bottom of reservoir. Cost, $13,000.

Distribution.—(Jan. 1, '90.) *Mains*, 8 to 4-in. w. i. and cem., c. i., about 13 miles. *Services*, galv. i. *Taps*, about 550 families supplied. *Meters*, none. *Hydrants*, Holyoke, Ludlow, 33. *Valves*, Bigelow, Ludlow.

Consumption, not given. *Pressure*, 80 lbs.

Financial.—Cost, withheld, est., $90,000. Cap. stock, $20,000. Debt and int., withheld. Ann. op. exp., withheld, est., $1,200. Ann. rev.: total withheld, est., $8,000. Hydrant rental, $20.

Management.—Prest., David Torrance, Birmingham. Secy., Treas., Supt., J. A. Fisk.

BETHEL, *Fairfield Co.* (Pop., 1,767.) In valley surrounded by high hills. Incorp. a borough in '48. No sewers or electric lights.

History.—Built in '78 by borough. Engr., W. B. Rider, So. Norwalk. Contr., D. A. Chappell, Chicago.

Water Supply.—Surface water, by gravity from impounding reservoir on small stream. Drainage area, about 175 acres.

Dam and Reservoir.—Cap., about 96,000,000 galls.; area flooded, 34 acres. Dam of gravel, with heart-wall; 174 ft. long, 22½ ft. high at highest point, 15 ft. wide on top, 82½ ft. at bottom. Water about 4 ft. below top of dam. Inner slope, 2 to 1, paved; outer, 1½ to 1. Is 175 ft. above, and 1½ miles from village. Material inside heart-wall selected, outside, ordinary gravel. *Heart-wall:* stone in cem., with puddle wall on inner side; about 2 ft. thick, extending to top of dam. *Spillway:* in rock at extreme end of dam, 40 ft. wide, 4 ft. deep at overfall, with considerable slope; free. *Discharge-pipe:* 12-in. *Gate-chambers:* masonry, with end walls 3, and side walls 2 ft. thick; one compartment 4 ft. sq., another 4x10 ft., separated by 2-ft. wall. Does not leak. Built in '78. Engr. and contr., see History. Cost, $25,000.

Filter.—Material, charcoal and sponge; first compartment, 4x6 ft., second, 4x2 ft., each 14 ft. deep; third compartment, size not given; contains clear water.

Distribution.—*Mains*, 12 to 4-in. c. i., 8 miles; laid by Inman Bros., New York City. *Services*, w. i. *Taps*, 446. *Meters*, none. *Hydrants*, Mathews, 58. *Valves*, Chapman.

Consumption, not given. *Pressure:* Ordinary, 70 lbs. Fire, 70 lbs.

Financial.—Cost, $30,000. Debt, $25,000. Int., 6%. Sinking fund, none. Ann. op. exp., $250. Ann. rev.: consumers, $1,200; city, none. First cost, $26,100.

Management.—Three Comrs. Treas., S. S. Ambler. Secy., H. H. Woodman. Supt., E. C. Oakley.

BIRMINGHAM, *New Haven Co.* (Pop., 3,026: est., 7,000.) At junction of Housatonic and Naugatuck rivers. Incorp. Has sewers and electric lights.

History.—Built in '60 by Birmingham Water Co., who also supply village of Derby.

Water Supply.—Springs and surface water, by gravity from reservoirs.

Reservoirs.—Cap., not given; area, 27 and 9 acres, respectively; sites formerly, swamps. *Dam No.* 1: stone, with earth filling, 500 ft. long, about 12 ft. high; cost, $11,700. *Dam No.* 2: stone, with earth filling, 200 ft. long, about 12 ft. high; cost, $13,300.

Supply Main.—C. i., 12 and 8-in., 2,054 ft. long.

Distribution.—*Mains*, 16 to 6-in., c. i., 8 miles. *Services*, w. i. *Taps*, about 400. *Meters* 2. *Hydrants*, kind not given, 48.

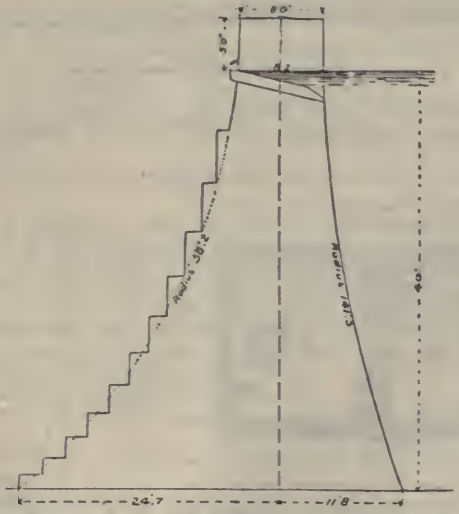
Consumption, unknown. *Pressure*, 60 to 100 lbs.

Financial.—(For '87.) Cost, $100,000. Cap. stock, $65,000. Debt, 23,000. Int. 5%. Ann. op. exp., $2,300. Ann rev.: consumers, $8,500; city, $1,500. Hydrant rental, $30. First cost, $28,000.

Management.—Prest., Wm. B. Wooster. Secy., and Treas., David Torrance Agt. and Supt., Chas. H. Nettleton.

BRIDGEPORT, *Fairfield Co.* (Pop., 27,543; est., 45,000.) On Inlet of Long Island Sound, at mouth of Pequonnock river; mostly on small plain, back of which is Gold hill rising to height of 60 ft., covered with residences. Has many manufactories. Incorp. borough in '20, city in '36. Has electric lights.

History.—First system built in '18 by Rev. Elijah Waterman, who conveyed water through wooden pipes from springs on Gold hill. These works changed hands in '23 and '48, having been extended from time to time. In '53 Nathaniel Green started a company which in '57 became Bridgeport Hydraulic Company. In '86 Citizens' Water Co. began construction of works with Chas. H. Pierce, Providence, R. I., Des. Engr., and Hull & Palmer, Bridgeport, Const. Engrs.; Coles & Jellette, Contrs., Jacoby & Madden, Sub-contrs., for pipe-laying; pipe and hydrants bought of R. D. Wood & Co., Philadelphia, Pa. Injunction was served by Bridgeport Hydraulic Co., which prevented new company from bringing their mains inside city. Later, the two Cos. consolidated as the Bridgeport Hydraulic Co., and in '88 connection was made between the two systems.



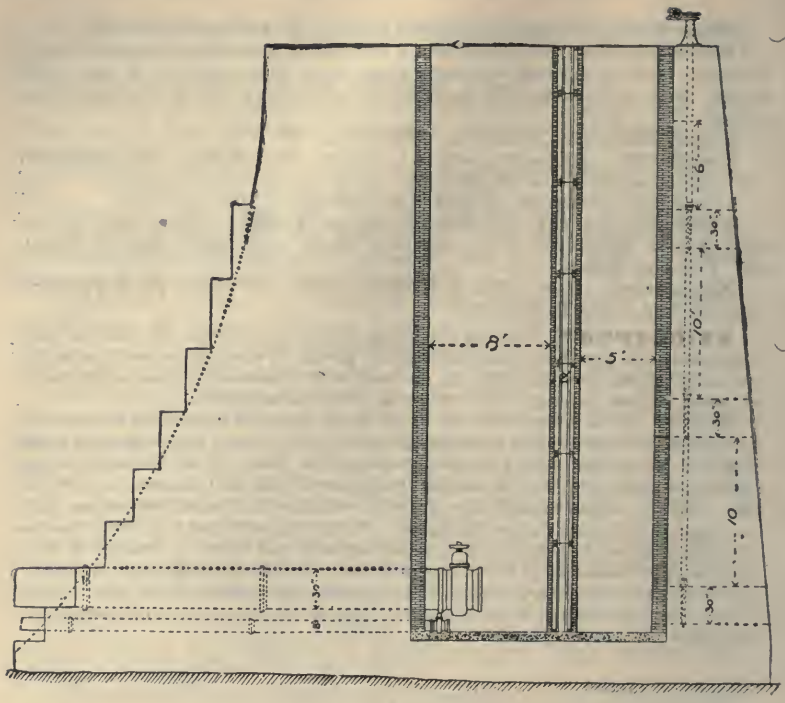
Cross-Section of Mill River Dam, Bridgeport, Conn.

Water Supply.—Ox and Island brooks, Pequonnock and Mill rivers. First three sources were drawn upon by the older Co., and last by younger.

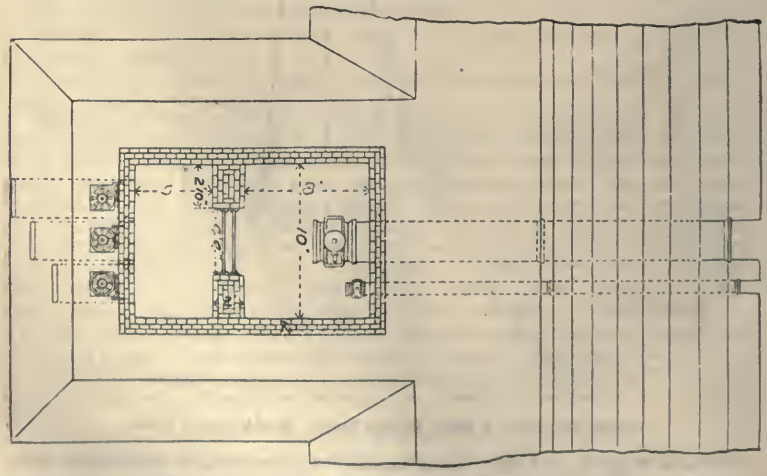
Storage Reservoirs.—Combined cap., 555,000,000 galls.: 50,000,000 on Ox brook, 80,000,000 on Island brook, 180,000,000 Pequonnock river; latter built in '78, 175 ft. above the tide-level, area of 50 acres, depth of 10 ft. Citizens' Co. built 50-acre reservoir containing 245,000,000 galls. See accompanying illustrations of dam forming latter reservoir.

Filter.—Charcoal.

Distributing Reservoir.—Cap., not given.



Section through Gate-Chamber.



Plan of Gate-Chamber.

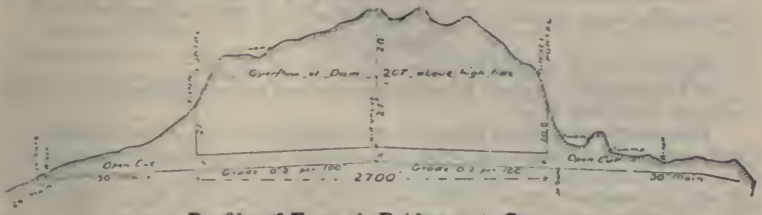
Mill River Dam, Bridgeport, Conn.

Pumping Machinery.—Dy. cap., not given; Worthington, 16-in. cylinder, 48-in. stroke. Seldom used.

Tunnel.—In connection with Mill river supply, 2,700 ft. long. See accompanying profile.

Distribution.—*Mains*, w. i. and cem., est., 90 miles: 60 miles in '83; 6 miles added by Citizens' Water Co., and 6 miles added in '88. *Services*, lead and w. i. *Taps*, 3,500 in '83. *Hydrants*, Mathews, 307.

Consumption, 5,000,000 galls. *Pressure*, 40 to 50 lbs.



Profile of Tunnel, Bridgeport, Conn.

Financial.—Cost (in '83), $800,000. Works of the Citizens' Water Co., cost $325,000, and their cap. stock was $300,000. Rev., city, $7,500. Hydrant rental, $25. No further data can be obtained. *Est.*: ann. op. exp., $8,000. Ann. rev.: consumers, $80,000.

Management.—Prest., W. D. Bishop. Secy., C. H. Bond. Treas., T. B. De Forest. Supt., Geo. Richardson.

Reference.—For further details regarding dam, reservoir, and tunnel, see *Eng. News*, vol. xvii., p. 230.

BRISTOL, *Hartford Co.* (Pop., 2,763; est., 4,000.) Is 17 miles west of Hartford. Manufactures clocks, hardware and knit goods. No sewers. Has electric lights.

History.—Built in '85 by Bristol Water Co. Des. Engr., H. W. Ayers. Const. Engrs., H. W. Ayers and R. D. Barnes.

Water Supply.—Poland brook, by gravity from impounding reservoirs.

Reservoirs.—*Old:* cap., not given; area, 28 acres. *New:* cap., 95,000,000 galls.; area, 19 acres; under construction in '89.

Distribution.—*Mains*, c. i., 14.9 miles. *Services*, galv. i. *Taps*, 360. *Meters*, 3. *Hydrants*, Ludlow, 60 public. *Valves*, Ludlow.

Consumption, est., 500,000 galls. *Pressure*, 60 to 130 lbs.

Financial.—Cost, $110,000. Cap. stock, $60,000. Bonded debt, $46,000. Int., 5 and 6%. Ann. op. exp., $1,000. Ann. rev.: consumers, withheld, est., $9,000; city, $1,200. Hydrant rental, $20.

Management.—Prest., J. H. Sessions. Secy. and Treas., C. S. Treadway. Supt., T. H. Keirns.

CANAAN, *Litchfield Co.* (Pop., est., 600.) One mile west of Housatonic river, on sandy plain broken by limestone ridges rising 10 to 100 ft. above river-level, village being 670 ft. above sea-level. Settled in 1740. No sewers or electric lights.

History.—Built in '79 by Canaan Water Co. Engr., W. A. Pettee.

Water Supply.—Springs, by gravity from impounding reservoir.

Dam and Reservoir.—Cap., not given. Dam of stone, 150 ft. long, 12 ft. high.

Distribution.—*Mains*, c. i., 3 miles. *Services*, w. i. *Taps*, 93. *Meters*, none. *Hydrants*, Holyoke, 5. *Valves*, Peet.

Consumption, unknown. *Pressure*, 35 to 70 lbs.

Financial.—Cost, $8,000. Debt, none. Ann. op. exp., $150. Ann. rev.: consumers, $900; city, none.

Management.—Prest., Luman Foot. Treas., J. W. Peet. Secy., S. A. Eddy. Supt., S. A. Bennett.

CONNECTICUT STATE INDUSTRIAL SCHOOL FOR GIRLS
Middletown, Middlesex Co. (Pop., not given.)

History.—Built in '80 for school by C. F. Browing, Treas. Engr., E. P. Augur.

Water Supply.—Springs and surface water, by gravity from impounding reservoir.

Dam and Impounding Reservoir.—Cap., 5,000,000 galls. Dam of earth, 300 ft., long, with puddle heart-wall.

Distribution.—*Mains*, w. i. and cem., 1.4 miles. *Services*, lead, w. i. *Taps*, 40. *Meters*, none. *Hydrants*, Holyoke, 4. *Valves*, Holyoke.

Consumption, not given. *Pressure*, 40 lbs.

Financial.—Cost, $12,000. No debt, exp. or rev.

Management.—Supt., Wm. G. Fairbank.

DANBURY, *Fairfield Co.* (Pop., 11,666; est., 18,000.) Has manufactories. Incorp. a borough in '22; a city since. Has sewers and electric lights.

DANBURY WATER CO.

General Description.—Introduced water in '33 through 1-in. lead pipes. In '81 still supplied many families. Not stated whether Co. is still in existence.

PRESENT WORKS.

History.—Built in '61 by borough. Engr., Jno. W. Bacon.

Water Supply.—Surface water, by gravity from impounding reservoirs. Drainage area, about 1,000 acres.

Dam and Impounding Reservoirs.—Combined cap., not given. Dams No. 1 and 2 were carried away in '69, owing, it is said, to frost penetrating to water-line. They were immediately rebuilt. *Dam No.* 1: cap., 40,000,000 galls.; area. 6 acres; 200 ft. above main street; earth, puddle heart-wall; 300 ft. long, 25 ft. high. *Dam No.* 2: cap., 150,000,000 galls.; area, 30 acres; built in '66, further up stream. *Dam No.* 3: cap., not given; stone, on another stream, 200 ft. above village. Built in '81. Engr., Wm. E. Worthem. *Dam No.* 4: built recently. Engr., W. B. Rider, So. Norwalk. No other data.

Supply Mains.—One of these is of 10-in. w. i. and cem., 1¼ miles long.

Distribution.—*Mains,* 20 to 3-in., w. i. and cem., 35 miles. *Services,* galv. i. *Taps,* 2,600. *Meters,* none. *Hydrants,* Holyoke, 230. *Valves,* Ludlow.

Consumption, unknown. *Pressure,* 75 to 80 lbs.

Financial.—Cost. $300,000. Bonded debt, $232,000. Int., 7, 4 and 4½%. Ann op. exp., $3,000. Ann. rev. consumers, $26,000; city, none. First cost, $37,500.

Management.—Secy., N. T. Bulkley. Supt. C. B. Mason.

DANIELSONVILLE, *Windham Co.* (Pop., 3,118; est., 4,000.) In Killingly and Brooklyn townships, on Quinnebaug river. Manufactures shoes, shuttles, belts and cotton and woolen goods. Incorp. a borough. No sewers or electric lights.

History.—Built in '86 by Crystal Water Co., under perpetual charter. Engrs.: and Contrs., Wheeler & Parks, Boston, Mass.

Water Supply.—Higgins brook, by gravity from impounding reservoir. Brook fed by springs.

Dam and Impounding Reservoir.—Cap., 16,000,000 galls.; area flooded, 6 acres. Dam not described. Contr., L. J. Wright.

Fire Reservoir.—Cap., 750,000.

Distribution.—(Aug., '89.) *Mains,* 12 to 4-in. c. i., w. i. and cem., 9 miles. *Services,* ¾-in. enam. i. Pipe and specials from M. J. Drummond, New York City; laid by Ferris & Halladay, Jersey City, N. J. *Taps,* 125; *Meters,* Crown, 1. *Hydrants,* Coffin, 50 public, 4 private. *Valves,* Coffin.

Consumption, unknown. *Pressure:* Ordinary, 55 lbs. Fire, 75 lbs.

Financial.—Cost (to August, '89), $120,000. Cap. stock issued, $80,000. Bonded debt, $50,000. Int., 5%. Ann. op. exp., $300. Ann. int., $2,500. Ann. rev.: consumers· $1,800; city, $1,500; hydrant rental, $30; 20 years contract.

Management.—Prest., T. E. Hopkins. Secy., M. P. Dowe. Treas., Elbert Wheeler, 24 Washington St., Boston, Mass.

DERBY, *New Haven Co.* (Pop., est., 4,000.) A village in town of Derby, near Birmingham. Has various manufactories. See Birmingham.

DURHAM, *Middlesex Co.* (Pop., 990; est., 1,000.)

History.—Built for domestic supply in 1798 and rebuilt in '32 by Durham Aqueduct Co., which consist of heads of about 40 families.

Water Supply.—Cold spring, by gravity. Spring walled up 4 x 5 ft., x 4 ft. deep.

Distribution.—*Mains,* 4-in. w. i. and cem., 2-in. lead, 1.8 miles. *Services,* lead. *Taps,* 40.

Consumption, unknown.

Financial.—Cost, not given, est., $8,000. Tax is levied on each family annually to meet exp. for repairs.

Management.—Three Directors. Prest., F. Hubbard.

GREENWICH, *Fairfield Co.* (Pop., 942; est., not given.) Is 27 miles east of N. Y. City, on Long Island Sound. Place of residence for many New York business men. Incorp. Has sewers. No electric lights.

History.—Built in '80 by Greenwich Water Co. Des. Engr., W. B. Rider, South Norwalk. Const. Engr., Jno. W. Rutherfoord and Wm. S. Barrett. Contr., Wm. Sherman, now of Troy (N. Y.) Public Works Co.

In 84 works were extended to connect with distribution at Port Chester, N. Y. Engr., W. B. Rider. Contr., P. Condon. The Port Chester extension also supplies Rye and Harrison, N. Y.; an extension of the Greenwich plant supplies Bell Haven.

Water Supply.—Putnam lake, by gravity.

Dam and Lake.—Cap. 300,000,000 galls.; increased from 191,000,000 in '87; 4 miles from Greenwich. Dam of earth, with heart-wall; origina ly 400 ft. long, 25 ft. high, 20 ft wide on top; (raised 5 ft. in '87) inner slope, 2 to 1, outer, 1¼ to 1. *Heart-wall*, material not given; 4 ft. thick at bottom, 1½ at top. *Spillway:* original lined with dry stone: new, cut stone masonry.

Filters.—Dy. cap., 1,300,000 galls.; Hyatt; erected Sept., '87.

Supply Mains.—A 12-in. main extends from lake for 3 miles, then wyes into two 10-in., to Greenwich 1, to Port Chester, 3 miles long.

Tank.—Cap., 1,250,000 galls.; 80 ft. in diam., 35 ft. high. Built in '89, 2 miles from reservoir, to supplement 12-in supply main.

Distribution.—*Mains*, c. i., 25 miles. *Services*, lead. *Taps*, 295. *Meters*, 6. *Hydrants*, Mathews, 40.

Consumption, 500,000 galls. *Pressure*, 50 lbs.

Financial.—Cost (in '82) $84,000, and no debt then. Hydrant rental, $26.63. No further data given.

Management.—Prest., A. Foster Higgins. Secy., Geo. G. McNall. Treas., Wm. Rockefeller, 26 Broadway, N. Y. City. Supt., Jno. Dayton.

GROTON, *New London Co.* (Pop., est., 1,500.) On east bank Thames river, opposite New London. See Stonington.

HARTFORD, *Hartford Co.* (Pop., 42,015; est., 48,000.) On Connecticut river, on irregular ground, at head of sloop navigation. Engaged in commerce and manufacturing. Settled in 1635; incorp. a city in 1784. Has sewers and electric lights.

History.—Built in '54 by city when pop. was about 20,000. These works consisted of a pumping station and 8,000,000-gall. reservoir on Asylum hill, 6,876 ft. distant. Water was taken from Connecticut river. This supply is seldom used now, gravity works having been built in '65-67. Engrs. of the latter, Geo. Marsh and Saml. M. Gray, Providence, R. I.

Water Supply.—Brooks, by gravity from storage reservoirs; also emergency supply from Connecticut river, by direct pumping. Drainage area of gravity supply, about 10 miles.

Dams and Storage Reservoirs.—Combined cap., 1,270,762,000 galls. Nos. 1, 2, 3 and 5 are in West Hartford, No. 4 in Farmington; each about 5 miles from and 260 ft. above city. *Reservoir No.* 1: cap., with 34 ft. of water, 146,000,000 galls.; area flooded, about 30 acres, on Trout brook. Dam of earth, with heart-wall; 782 ft. long, 53 ft. high, top 6.3 ft. above water; 27 ft. wide on top, with inner slopes 2 to 1; outer, 2 to 1. *Heart-wall:* puddle, 25 ft. thick at bottom, bedded in rock, 4 ft. thick at top, which is 3 ft. from top of dam. *Spillway:* 42 ft. long. No other data. *Discharge-pipes:* 3 20-in.—one a waste pipe—pass through base of dam. Built in '65-6. Cost, including damages, supply pipes, etc., $205,543.

In '67 this dam gave way, owing to a heavy freshet which destroyed a partially constructed dam on stream above; extra volume of water washed banks of reservoir, overflowed and cut channel in dam No. 1, which enlarged until dam was destroyed. About 200,000,000 galls. of water was discharged into valley below, doing much damage. Failure was in Sept., and by Dec. of same year dam had been rebuilt under direction of Wm. J. McAlpine, deceased.

Reservoir No. 2: cap., with 41 ft. of water, 283,694,000 galls; area flooded, 44 acres; on Mine brook, about 0.1 mile north of No. 1. Dam of earth with heart-wall; founded on rock; 1,300 ft. long, originally 42 ft. high, with water 5 ft. from top; 27 ft. wide on top, with inner slope 3 to 1, covered with riprap, outer 2 to 1. *Heart-wall:* puddle, founded on rock, 25 ft. thick at bottom, 4 at top, which is 3 ft. from top of dam. *Spillway:* 56 ft. long. *Discharge pipes:* a 20 and a 12-in., extending through dam. Built in '68.

Reservoir No. 3: cap., with 36 ft. of water, 145,596,000 galls.; area flooded, about 25 acres; on branch, and about 1 mile northwest of Trout brook, in valley bordered by hills of trap rock; site of reservoir originally wooded, but cleared and grubbed before flooded. About 6 acres of muck at upper end were covered with 3 ft. of gravel. Dam of earth, with heart-wall, founded on puddle 25 ft. wide and 19 ft. deep, to rock; 56 ft. long at top, 170 at bottom, 42½ ft. high, above bed of stream,

with top 5½ ft. above water; 225 ft. wide at base, 50 at high-water line, 30 at top; inner slope, 3 to 1, covered with 30 ins. of riprap; outer, 2 to 1, sodded. *Heart-wall:* puddle, similar to those in Nos. 1 and 2. *Spillway:* 25 ft. wide, depth and slope not given; begins 700 ft. above dam, which it passes 100 ft. from end, and discharges into stream 300 ft. below. *Discharge pipes:* a 20 and a 16-in., inclosed in puddle wall, with screens at intake end. *Dykes:* one 310 ft. long, 5 ft. high, to prevent flow of water to Mine brook; one 125 ft. long, 4 ft. high, to prevent flow to south end of reservoir No. 2, which is 6 ft. lower than No. 3. Both dykes faced with riprap.

In '77 dam leaked: repaired by laying strip of puddle wall along bottom of inner slope. Built in '75. Engr. and Contr., not given. Cost, $59,117.

Reservoir No. 4: cap., with 20 ft. of water, 601,354,000 galls.; area flooded, not given; dam across ravine receiving discharge of two brooks; earth, with heart-wall. Foundation of puddle on rock. Bank built with 6-in. layers, watered and rolled. Dimensions not given. *Heart-wall:* concrete, carried to rock. *Dyke:* 1,200 ft. long; built to prevent water backing across divide at upper end of reservoir. Dam completed in '80, though begun some time before this. (Probably the unfinished dam that broke and destroyed No. 1.) Engr., Wm. E. Worthen, N. Y. City.

Reservoir No. 5: cap., with 23 ft. of water, 94,132,000 galls.

Conduits and Canals.—A 12-in. pipe connects reservoirs Nos. 2 and 3; 561 ft. of 16-in. cem. pipe, and 15,279 ft. of canal connect reservoir No. 4, in Farmington, with reservoir No. 1. Until recently whole supply had to pass through reservoir No. 1 to supply mains. In '89 canals were completed, making it possible to draw the supply from any of reservoirs Nos. 2 to 5, independently of No. 1.

Supply Mains.—Two 20-in., each 25,948 ft. long, from reservoir No. 1 to city: originally w. i. and cem., which lasted 6 to 10 years, then rapidly oxidized, as hemp-caulked joints were very leaky in soft ground. This is being replaced by c. i.

Asylum Hill Distributing Reservoir.—Cap., with 30 ft. of water, 10,000,000 galls.; in embankments, 360x168 ft. at high-water line, 30 ft. above bottom. Inner slopes, 1 to 1, riprapped; outer, 1½ to 1. *Heart-wall:* puddle, dimensions not known. *Gate-house:* 20½x22 ft., two compartments. An 8-in. force main enters chamber and a 16 and an 8-in. supply main leads from it. There is also an 8-in. drain pipe. Built in '55, in connection with pumping works. [In April, '79, the waste-gate was opened by some unknown person, and the reservoir emptied. East and west slope walls slid in, necessitating repairs, after which but 25 ft. of water was admitted. Steepness of inner slope probable cause of collapse. For some time this reservoir has been but little used.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; designed by Wm. Wright; built by Woodruff & Beach, Hartford. Original pumps built in '55, and replaced by above.

Distribution.—*Mains*, 20 to 4-in., c. i. w. i. and cem. i., 83 miles. *Services*, galv. i. *Taps*, 5,984. *Meters*, 315. *Hydrants*, Ludlow, Holyoke, 488. *Valves*, Ludlow.

Consumption, 5,000,000 galls. *Pressure*, 60 lbs.

Financial.—Cost, $1,743,168. Debt, $827,000. Int., 5 and 6%. Sinking fund, none. Ann. op. exp., $28,940, including $10,159 for repairs, charged to construction. Ann. rev.: consumers, $139,415; misc., $3,231; city, $12,114. Hydrant rental, $20. First cost, $336,948; to close of '69, $520,356; '70, $997,309; '80, $1,495,519. Op. exp. and repairs: '60, $8,471; '70, $21,591; '80, $36,297. Rev.: '60, $30,048; '70, $81,638; '80, $121,281. Total op. exp. and repairs, $780,032; total int. on bonds and loans, $1,453,671 Total exp. and int., $2,233,703. Total rev., $2,874,873. Net rev., $641,170.

Management.—Six Comrs. Prest. and Supt., Ezra Clark. Secy., J. Seymour Chase.

KENT, *Litchfield Co.* (Pop., est., 250.)

History.—Built in '82 by Kent Water Co. Engr., W. B. Rider, So. Norwalk. Contrs., C. T. Leonard & Son, So. Norwalk.

Water Supply.—Springs and surface water, by gravity from reservoir.

Reservoir.—Cap., not given; area, 1½ acres; depth, 2 to 18 ft.

Distribution.—*Mains*, c. i., 2.3 miles. *Services*, w. i. *Taps*, 40. *Meters*, none. *Hydrants*, Mathews, 10. *Gates*, Ludlow or Chapman.

Consumption, unknown. *Pressure*, 65 lbs.

Financial.—Cost, $15,500. Cap. stock, $15,000. No debt. Ann. op. exp., $55 Ann. rev.: consumers, $500; city, none. Hydrant rental, free.

Management.—Prest., Luther Eaton. V. Prest., Secy. and Supt., C. A. Eaton. Treas., C. H. Gaylord.

LITCHFIELD, *Litchfield Co.* (Pop., 452; est, 2,000.) Has manufactories.

History.—Under construction '89-90 by town. Engr., T. H McKenzie, Southington. Consult. Engr., J. J R. Cross, N. Y. City.

Water Supply.—Griswold brook, 4¼ miles from town, from gravity from impounding to distributing reservoir.

Dam and Impounding Reservoir.—(Unofficially reported.) Cap., not given; area, about 5 acres. Dam 500 ft. long, 25 ft. high. Contr., J. S. Smith, N. Y. City. Contract price, about $17,000.

Conduit.—Betweed reservoirs. Diam., not given; length, about 4 miles.

Distributing Reservoir.—Contract (was) to be let Mar. 15. No further data.

Distribution.—Pipe and specials from R. D. Wood & Co., Philadelphia Pa. trenching and pipe-laying, including supply main, done by Moore & Shaler, Newburg, N. Y. *Hydrants*, Mathews, *Valves*, Eddy,

Management.—Prest., F. H. Wiggins. Treas., C. B Bishop. Reports by T. H. McKenzie; date of latest, Feb. 20, '90.

MANCHESTER, *Hartford Co.* (Pop., est., 2,000.) Is 8 miles from Hartford. Manufactures paper. Incorp. village. No sewers or electric lights.

History.—Built in '89 by Manchester Water Co., under perpetual franchise; put in partial operation July 15, and in full, Sept. 1, '89. Engr., E. H. Phipps, New Haven. Contrs., Conn. Patent Water Pipe Co., New Haven.

Water Supply.—White's brook, by gravity from impounding reservoir.

Reservoir.—Cap., 2,500,000 galls.

Distribution.—*Mains*, w. i. and cem., 7½ miles; from contrs. *Services*, galv. i. *Hydrants*, Ludlow, 45. *Valves*, Ludlow.

Pressure, 65 to 75 lbs.

Financial.—Cost, $50,000. Cap. stock, $20,000. Bonded debt, $28,000. Int., 5%. Hydrant rental, $1,000 for 37, or about $27 each.

Management.—Prest., Wm. Foulds. Secy., Treas. and Supt., W. H. Childs. Reports by E. H. Phipps; dates, Apr. 22 and Sept. 5, '89.

MERIDEN, *New Haven Co.* (Pop., 15,500; est., 23,000.) In rolling country. Manufactures silver-plated and Britannia goods, cutlery, steel pens, guns, glassware, cabinet organs and all kinds of hardware. Incorp. a city in '67. No sewers. Has electric lights.

History.—Built in '69 by city. Engr., Geo. H. Bishop; for extensions in 76-8, including dams, canals and new supply main, T. H. McKenzie, Southington.

Water Supply.—Surface water, by gravity from impounding reservoir. Drainage area, 800 acres.

Dams and Reservoir.—Cap., 300,000,000 galls; formed by two earth dams, 25 ft. high, built between two high hills 1 mile from and 250 ft. above village

Supply Main.—W. i. and cem., 5½ miles long; 3 miles of 12, 2½ of 16-in.

Distribution.—*Mains*, c. i., w. i. and cem., 33 miles. *Services*, galv. i. *Taps*, 2,700. *Meters*, 85. *Hydrants*, Chapman, Mathews, Whittier, Holly, 216. *Valves*, Chapman, Ludlow.

Consumption, 1,250,000 galls. *Pressure:* Ordinary, 100 lbs. Fire, 115 lbs.

Financial.—Cost, $380,000. Debt, $200,000. Sinking fund, $90,000. Int., 3½%. Ann. op. exp., $8,000. Ann. rev.: consumers, $51,060. Hydrant rental, $30.

Management.—Supt., Jno. B. Dunlap.

MIDDLETOWN, *Middlesex Co.* (Pop., 6,826; est., 10,000.) On Connecticut river, on ground rising from river 175 ft. in ¾ miles. Has many manufactories and large trade. Settled in 1650; incorp. a city in 1784. Has sewers and electric lights.

History.—Built in '66 by city. Engr., Geo. A. Bishop.

Water Supply.—Surface water, by gravity from impounding reservoir taking drainage from ⅛ sq. m.

Dam and Reservoir.—Cap., est., 200,000,000 galls.; area, 76 acres; av. depth, 10 ft.; 168 ft. above main business street, 45 ft. above highest residence district. *Dam:* earth, across ravine

Filter.—Double wall of brick filled between with stone and gravel. No way was provided for cleaning this, and in warm weather water is better from outside.

Distribution.—*Mains*, c. i., w. i. and cem., 18.26 miles. *Services*, galv. i., w. i. and c m. *Taps*, 1,245. *Meters*, none. *Hydrants*, Holyoke, Ludlow, 103. *Valves*, Eddy, Chapman.

Consumption, 800,000 galls. *Pressure*, 60 lbs.

Financial.—Cost, $247,486. Debt, $139,000: $64,000 at 6, $20,000 at 4, $55,000 at 3.65%. Sinking fund, $9,500. Ann. op. exp., $3,251. Ann. int., $6,647. Ann. rev.: consumers, $19,120; misc., $137; city, $2,776. Hydrant rental, $25 and $30.

Management.—Comrs. Prest., Jas. Lawton. Secy. and Supt., J. C. Broatch.

MYSTIC, *New London Co.* See Stonington.

NAUGATUCK, *New Haven Co.* (Pop., 4,274; est., 6,000.) Is 5 miles from Waterbury. Engaged in manufacturing. Not incorp. No sewers. Has electric lights.

History.—Built in '88-9 by Naugatuck Water Co. Engr., T. H. McKenzie, Southington. Contr., Franklin A. Snow, Providence, R. I.

Water Supply.—Straitsville brook, by gravity.

Dam and Reservoir.—Cap., 7,500,000 galls.; area flooded, 3½ acres. Dam of earth, with heart-wall; 380 ft. long, 32 ft. high, water 6 ft. from top; 16 ft. wide on top; inner slope, 2 to 1, covered with 2½ ft. of large and small stone; outer slope, 1½ to 1. Puddled loam between inner face and heart-wall; loam, gravel and stone between heart-wall and outer face. *Heart-wall:* concrete, 4 ft. thick at bottom, 3 at top, which is 4 ft. from top of dam; founded on masonry 6 ft. thick and 8 ft. high. *Spillway:* 80 ft. from end, 33 ft. wide, 6 ft. deep at overfall; excavated in earth, stone walls and paving, with plank apron at overfall; free. *Discharge-pipes:* two 12-in.; slope, 1 to 30. Dam does not leak. Built in '88-9. Engr., T. H. McKenzie, Southington. Contrs., earthwork, F. A. Snow, Providence; masonry, J. H. Dunn. Cost, $20,000.

Distribution.—*Mains*, c. i., 12 miles. *Services*, galv. i. Pipe and specials from R. D. Wood & Co., Philadelphia, Pa.; laid by the Co. *Taps*, 175. *Meters*, none. *Hydrants*, Ludlow, 70.

Consumption, not determined. *Pressure*, 110 lbs.

Financial.—Cost, $83,000. Cap. stock, $45,000. Bonded debt, $39,000. Int., 6%. Ann. op. exp. and rev., not determined. Hydrant rental, $21.43.

Management.—Prest., Homer Twitchell. Secy. and Treas., S. S. Scott.

NEW BRITAIN, *Hartford Co.* (Pop., 11,800; est., 20,000.) Is 10 miles from Hartford. Manufactures knit goods, jewelry and hardware. Incorp. borough, '50, a city in '73. Has sewers and electric lights.

History.—Built in '57 by city. Des. Engr., McRee Swift. Const. Engr., A. B. Chamberlain.

Water Supply.—Shuttle Meadow brook, by gravity from impounding to distributing reservoir. Reservoir called Shuttle Meadow lake. Drainage area, about 1½ sq. m.

Dam and Shuttle Meadow Lake.—Cap., est., 700,000,000 galls.; area flooded, about 175 acres; elevation of surface, 91 ft. Dam of earth (not known whether it has puddle wall, probably not), 410 ft. long, 16.48 ft. high, with top 2.95 ft. above water; 19 ft. wide on top; inner slope, 2 to 1, covered with 2 ft. of riprap; outer slope 1½ to 1. Founded on hard gravel, with some rock at each end. Dam from inner face to center, gravel, with some loam; remainder, coarse gravel. *Spillway:* near center, 30 ft. wide, about 3 ft. deep, with perpendicular overfall; paved and walled with masonry; free. *Discharge-pipes:* two, 24 and 16-in. Dam does not leak. Built in '57. Engr., A. Chamberlain, deceased. Contr., A. C. Lewis, New Britain. Cost, unknown.

It is proposed to enlarge and raise the dam by building upon its lower side and above it, increasing the height to about 28 ft., and raising the water 10 ft. The plan includes a heart-wall. This enlargement was designed in '84 by S. C. Heald, Worcester.

Conduit.—W. i. and cem., part 16 and part 12-in., 2½ miles long.

Distributing Reservoir.—Cap., not given; ¼ mile from and 146 ft. above business part of city; reserve.

Distribution.—*Mains*, c. i., w. i. and cem., 28 miles. *Services*, w. i. *Taps*, 3,700. *Meters*, 51. *Hydrants*, Chapman, Holyoke, 202. *Valves*, kind, do.

Consumption, 2,500,0 0 galls. *Pressure*, 75 lbs.

Financial.—Cost, $270,000. Bonded debt, $171,000. Int., 4 and 7%. Sinking fund $15,105. Ann. op. exp., about $5,000. Ann. rev.: consumers, $30,000; city, $4,750. Hydrant rental, $25. First cost, $50,000.

Management.—Three Comrs. Chn., Jas. W. Ringrose. Supt., D. A. Harris.

NEW HAVEN, *New Haven Co.* (Pop., 62,882; est., 80,000.) At head of New Haven bay, 4 miles from Long Island Sound; on sandy plain between West and Mill rivers and the Quinnipiack river. Has large inland, coast and foreign commerce and extensive manufactories. Incorp. a city in 1784. Has sewers and electric lights.

History.—Built in '60-62 by New Haven Water Co. Engr., Julius W. Adams, N. Y. City, who was succeeded in '61 by Thos. N. Doughty as Const. Engr. Phineas Ball was Engr. in '82 for new supply from Lake Saltonstall. In '76 village of Fair Haven became a part of city, and gravity works supplying village were purchased from Fair Haven Water Co. These have been developed into present gravity system.

Water Supply.—Mill river, Maltby and Wintergreen lakes and Lake Saltonstall, by gravity and pumping to reservoir. Drainage area: Mill river, 56 sq. m; lakes, over 5 sq. m.. Max. flow of river, est., 12,000,000 galls.

Impounding Dam.—On Mill river, forming Lake Whitney; cap., est., 500,000,000 galls.; backs water 2½ miles to depth of about 20 ft. Dam of heavy masonry in cem., with 8-in. concrete heart-wall from foundation to water line, and gravel filling on upper side; 500 ft. long; main dam 38½ ft. high; batter of face, 1 to 4, back, 1 to 3; 3¼ ft. thick at top, 25.7 at base, through part of length, 6 ft. at top, 28.45 ft. at base through remainder. Wing at west end, 6 ft. high, 3 ft. thick at top, 6 at bottom. Gravel embankment at deepest part of river, 20 ft. wide on top, 100 at bottom. *Overfalls:* one 150 ft. long at each end of dam. Dam at east overfall 36 ft. high, 858 ft. thick at top, 34.83 ft. at bottom; at west end, 38⅞ ft. high, 11.62 ft. thick at top, 34.12 ft. at bottom. Batter of inner face at each, 1 to 4, back, 1 to 1.71. *Gate-chamber and Conduit:* chamber in west wing, masonry, 4 ft sq., opening into 4 ft. w. i. pipe, 17 ft. above base of dam; supplies power to manufactory below, formerly owning water rights; also to old pumps.

Pumping Machinery.—Dy. cap., 15,000,000 galls.; 3,000,000 water-power, 6,000,000 old pumps, and 6,000,000 Worthington. First pumps were 16 ins. in diam., 60-in. stroke, driven by two 30-ft. back-pitch overshot wheels, each with 80 buckets, 6 ft. long. These were near dam. In '70 two horizontal, double-acting pumps, driven by a horizontal engine were added; located between dam and Sachem Hill distributing reservoir.

Force Main.—Originally 3,100 ft. of 16-in. c. i.; Sachem Hill to distributing reservoir. Connection can be made directly with distributing plant.

Distributing Reservoirs.—Combined cap., 17,000,000 galls. *Sachem Hill:* cap., 10,000,000 galls.; 129 ft. above tide water; in excavation and embankment, in two compartments, elliptical, 244 x 488 at water line, with 19 ft. of water, total depth of 23 ft.; banks 10 ft. wide on top. Inner slopes, 1 to 1, covered with 1½ ft. puddle, 4 ins. of concrete, 1 ft. riprap in cem.; outer, 1½ to 1. Bottom covered with 18 ins. of puddle, overlaid with 4 ins. of concrete. *Influent and effluent Chambers and Connecting Pipes:* chamber has foundations 28x24 ft., x 3 ft. deep; walls 6 ft. thick at bottom, 2½ at top; each in two compartments, 10½ ft sq.; influent chamber, 20 ft. 1½ ins., effluent, 18 ft. 7 ins. deep. Each chamber in compartment wall. Water can be discharged into either compartment of reservoir or through 16-in. main directly from force-main to effluent chamber.

Supply Mains.—Each 11,341 ft long, the first being of 16-in. c. i.; two 12-in. mains have been added.

Distribution.—*Mains*, c. i., w. i. and cem., 122 miles. *Services*, galv. l. *Taps*, no record, est., 8,500. *Meters*, 50. *Hydrants*, Bigelow, 716. *Valves*, Bigelow, Chapman. Mains at close of '80, 115 miles.

Consumption, 9,000,000 galls. *Pressure:* Ordinary, 25 to 50 lbs. High service, 80 lbs.

Financial.—Cost, $1,576,188. Cap. stock, $1,405,250. Bonded debt, $125,000. Int., 7%. No sinking fund. Ann. op. exp., withheld, est., $12,000. Ann. rev.: consumers, $193,337; city, $16,000 for all purposes, no separate allowance for hydrant rental. Cost to Dec. 31, '62, $357,000; to close of '80, $1,219,628.

Management.—Prest., Henry S. Dawson. Secy. and Asst. Treas., Ellsworth I. Foote. Supt., Sherman E. Grannis.

NEWINGTON, *Hartford Co.* (Pop., town. 934; est., 1,000.) Incorp. town.

History.—Built in '66 by Newington Water Co.; put in operation in Nov. Const. Engr., Lyman Wetherill, Newington.

Water Supply.—Stream or springs on Cedar Mountain, by gravity.

Distribution.—*Mains*, 2-in.

Financial.—Cost, $3,000. Cap. stock, authorized, all issued, $2,750. No debt. Ann. op. exp., $10. Ann. rev.: consumers stockholders.

Management.—Prest., Treas. and Supt., E. Kilbourne. Secy., Jno. S. Kirkham.

NOTE.—No further data. Report dated Mar. 4, '90.

NEW LONDON, *New London Co.* (Pop., 10,537; est., 13,000.) Near mouth of Thames river, on good harbor. Engaged in commerce and manufacturing. Summer resort. Founded in 1646; incorp. a city in 1784. Has sewers and electric lights.

OLD WORKS.

General Description.—First and partially supplied in '02 by Aqueduct Co. through logs from spring in northern part of city. In '40 lower streets and wharves were supplied through c. i. pipe from a mill pond in northern part of city, and also from well near Wilson Manufacturing Co.'s works in center of city, the latter supply being pumped by above company. In '50 the 4-in. pipe from mill pond had become obstructed with rust, and was replaced by a 6-in. w. i. and cem. pipe, which was in good order in '81. The 3-in. c. i. pipe from the Wilson works was also used as late as '81 in connection with the city works, under 140 ft. head.

PRESENT WORKS.

History.—Built in '72 by city. Des. Engr., J. T. Fanning, Minneapolis, Minn. Const. Engr., W. H. Richards, present Supt. High service system has been projected.

Water Supply.—Lake Konomoc, by gravity. Lake about 6 miles from city, between wooded hills; 180 ft. above tide level; drainage area, 1,296 acres. Original lake had area of 110 acres; raised 10 ft. by a dam 200 ft. below outlet, increasing area to 225 acres and giving a cap. of 600,000,000 galls.

Filter Dam.—Loose gravel, 20 ft. wide, 12 ft. high; one mile abeve dam at lake; used as driveway.

Dam.—Earth with heart-wall; 275 ft. long, 19 ft. high, with water 5 ft. from top; 25 ft. wide on top; both slopes 1½ to 1, inner, paved with 16 ins. of stone to within 5 ft. of top; from here vertical wall is carried up, 4 ft. thick at bottom, 2 at top. Between two hills of sand and gravel, upon about 2 ft. of hardpan underlaid with 4 to 10 ft. of quicksand; soil above hardpan was removed. Beneath inner half of dam, 20 ft. in front of heart-wall, 2-in. sheet piling, 10 ft. long, are driven, with upper ends extending about 3 ft. into dam. Inner part of dam puddled clay and gravel, 1 to 1; outer, ordinary earth. *Heart-wall:* rubble masonry, 4½ ft. thick at bottom, 2 at top, which is 3 ft. below top of dam, 2 above water; foundation of concrete, 2 ft. deep, 10½ ft. wide; beneath spillway, wall 9 ft. thick at bottom, 4 at top. *Spillway:* in center of dam, 25 ft. wide, 4 ft. deep, free (see heart-wall); lined with masonry in cem.; has chestnut plank apron laid in cement extending 12 ft. in front. *Gate-house:* masonry; chamber, 4 x 4½ ft., with screened opening in side 30 ins. wide; three 2 x 2½-ft. gates for drawing water at different levels. Above chamber, space 8 x 10 ft, x 9 ft. high contains hoisting machinery. *Discharge-pipes:* two, a 24 and a 16-in., with 16-in. blow off from 24-in pipe. Dam leaks slightly. Built in '72. Engrs., see History. Contr., Geo. Prest.

Supply Mains.—*Old:* first, 6,826 ft., Scotch clay pipe, in 3-ft. lengths, with w. i. and cem. sleeve-joints; head, 18 to 20 ft. At end of this section a 20-in. vertical pipe, 29 ft. high, is joined to main to lessen shock caused by shutting gate at dam. Remainder of old main, 27,900 ft. of 16-in. w. i. and cem. pipe. *New:* 20-in. c. i., laid in '89.

Distribution.—*Mains,* 16 to 3-in. c. i., w. i. and cem., 26.2 miles; extensions made with c. i. *Services,* w. i. and cem., lead; rubber-coated i. was first used, but this has been replaced with cem.-lined. *Taps,* 1,833. *Meters,* 37. *Hydrants,* Whittier, 137. *Valves,* Chapman, Ludlow. *Close of* '73: Mains, 16.3 miles. Taps, 200. Meters 2. Hydrants, 53. *Close of* '80: Mains, 20.9 miles. Taps, 1,201. Meters, 22. Hydrants, 106.

Consumption, est., 1,342,000 galls. *Pressure,* 34 to 55 lbs.

Financial.—Cost (to Sept., '88), $341,817. Debt, $250,000. Int., 7%. Ann. op. exp., $7,174; large, owing to accident to mains. Ann. int., $17,500. Ann. rev.: consumers, $23,575; misc., $1,030; city, none. Cost to end of '73, $196,720; '80, $289,701. Rev. for '73, $5,773; '80, $15,108.

Management.—Comrs. Prest., B. A. Armstrong. Secy., P. C. Dunford; Supt., W. H. Richards.

Reference.—"Accident on Tile Pipe Conduit." By W. H. Richards. *Journal N. E. W. Wks. Assn.*, June '89. *Eng. News,* Vol. XXII., p. 35.

NEW MILFORD, *Litchfield Co.* (Pop., 1,416; est., 1,500.) On Housatonic river, on succession of irregular terraces. Has some manufactories. Settled in 1707; incorp. town in 1712. Has sewers and electric lights.

History.—Built in '74 by New Bedford Water Co., under perpetual charter. Des. Engr., B. H. Hull, Bridgeport. Const. Engr., W. B. Stilson.

Water Supply.—Surface water, from mountain stream, by gravity from impounding reservoir. Drainage area, about 1,000 acres.

Dam and Impounding Reservoir.—Cap., 13,000,000 galls. Area, 1¼ acres; dam of stone masonry, grouted, 240 ft. long, 35 ft. high, 5 ft. thick at top, 29 at bottom. Highest part founded on rock. *Spillway:* in dam, 25 ft. from end, about 27 ft. wide, 3 ft. high at inner edge; slope, 1½ ft. through dam. Overflow falls on solid rock; controlled by gates. *Discharge-pipes:* two, 16 and 12 ins. in diam.; drawing water about 7 and 20 ft., respectively, from bottom; slope, slight. Dam leaks very slightly. Built in '83. Engr., B. H. Hull, Bridgeport. Contrs., Squires & Bartram, Sharon. Cost, $15,000.

Filter.—In reservoir, of brick, filled with sand, gravel and charcoal, through which water passes upward to open chamber, thence to supply-main.

Supply-Main.—C. i., 6-in., about 1¼ miles long.

Dam and Distributing Reservoir.—Cap., 2,000,000 galls; area, ¾ acres; 250 ft. above village. Dam of stone masonry, 140 ft. long, 22 ft. high, 4 ft. 10 ins. thick at top, 16½ at base. *Spillway:* in dam, 20 ft. wide, 2 ft. deep. Built in '74. Engr., B. H. Hull, Bridgeport. Cost, $9,203.

Distribution.—*Mains*, 6 and 4-in., c. i., 5 miles. *Services*, galv. i. Pipe and specials from, and pipe laid by, J. H. & M. S. Austin, New Britain. *Taps*, 175. *Meters*, none. *Hydrants*, Mathews, 34. *Valves*, Peet. *Close of '80*: Mains, 5 miles. Taps, 150. Meters, none. Hydrants, 32.

Consumption, unknown. *Pressure*, 100 lbs.

Financial.—Cost, $47,700. Cap. stock, $25,000. Debt, $10,500. Int., 5%. Ann. op. exp., $750. Ann. rev.: consumers, $4,012; city, $640. Hydrant rental, $20. Cost to close of '80, about $30,000. Rev. in '80, $2,850.

Management.—Prest., C. H. Booth. Secy., Treas., C. H. Noble. Supt., H. O. Warner.

NORWALK, *Fairfield Co.* (Pop., 5,308; est., 7,000.) Near mouth of Norwalk river, on Long Island Sound. Settled in 1640. Engaged in manufacturing. Incorp. Has sewers and electric lights.

History.—Built in '72 by borough. Des. Engr., Geo. H. Bailey. Const. Engr., J. F. Burgin.

Water Supply.—Silver Mine stream, by gravity from impounding to distributing reservoir. Drainage area, about 20 sq. m.

Dams and Impounding Rservoirs.—Cap., 120,000,000 galls. *Dam No. 1*: cap., 60,000,000 galls., 292 ft. above tide-level; stone, with earth backing, 230 ft. long, 22 ft. high above bed of stream, 10 ft. deep below. *Dam No. 2*: cap., 60,000,000 galls.; area, 14 acres; stone, 125 ft. long, 30 ft. high. Built in '83, 6 miles above No. 1, on same stream. Engr., Geo. W. Cram.

Conduit.—W. i. and cem., 12-in., 6 miles, leading to distributing reservoir.

Distributing Reservoir.—Cap., 4,500,000 galls.; on steep hill, 192 ft. above tide-level; in excavation and embankment, with heart-wall; 260 ft. in diam. at water surface, 16 ft. deep. Both slopes, 1½ to 1, inner lined with riprap.

Filter.—Sponge, in gate-house.

Distribution.—*Mains*, c. i., w. i. and cem., 27 miles. *Services*, w. i. and cem. *Taps* (in '87), 850. *Meters*, none. *Hydrants*, Mathews, 110. *Valves*, Ludlow.

Consumption, about 700,000 galls. *Pressure*, 80 lbs.

Financial.—Cost, about $260,000. Debt, about $200,000. Int., 4%. Ann. op. exp., $1,500. Ann rev.: consumers, $12,000.

Management.—Comrs. Secy., A. H. Camp. Supt., Francis Leonard.

NORWICH. *New London, Co.* (Pop., 15,112; est., 18,000.) At confluence of 3 small streams forming Thames river; at head of navigation, 15 miles from Long Island Sound. Engaged in commerce and manufacturing. Incorp. Has sewers and electric lights.

History.—Built in '66-8 by city, when pop. was about 15,000. Engr., Jno. T. Fanning, Minneapolis, Minn.

Water Supply.—Brooks and springs, by gravity from impounding reservoir. Drainage area, 1,233 acres; original, 483 acres; meadow brook, 750 acres.

Dam and Impounding Reservoir.—Cap., 350,000,000 galls.; area, 66 acres; depth, 16 ft.; elevation at overflow, 240 ft. above mean tide. Reservoir has av. width of 480 ft.; length, 1¼ miles; rubble masonry wall, 3 ft. high, built clear round reservoir. Stumps were cleared from site Dam of earth with heart-wall; 486 ft. long, 25 ft. high, 25 ft. wide on top, with water 4 ft. below same. Inner slope 2 to 1, convex near base, covered with 1½ ft. of riprap; outer, 1½ to 1. *Heart-wall:* rubble masonry in cem., 5 ft. thick at base, 2 at top, founded on rock; top rises above water-level. *Gate-house:* masonry, 8 ft. in diam. *Discharge-pipes:* 4, extending through dam; 16-in. waste-pipe from reservoir, 8-in. drain-pipe from gate-house, parallel to and connected with waste-pipe; 16 in. supply, and 10-in. branch supply-pipe, also connected at lower slope of dam. The 16-in. supply has a Y branch in gate-house with ends curved and flanged to receive ⊥-shaped end of intake pipe, thus forming flexible joint, and providing for movement in vertical plane. Length of intake-arm, 27 ft.; of copper, with screen on end; by means of pulleys and weight in gate-house can be raised and lowered to take water from any depth, and screen can be raised above water. The 10-in. branch supply main extends vertically upwards inside of dam, with screen at end a little below water-surface.

Filtering Dams: two, at inlet of streams tributary to reservoir.

Proposed New Dam and Reservoir.—Cap., 1,000,000,000 galls.; area, 200 acres; elevation of overflow, 275 ft. above mean tide. To be on Meadow brook. (See Conduit.)

Conduit.—Pending construction of proposed dam Meadow brook supply is brought to present reservoir through 7,160 ft. of 24-in c. i. pipe.

Supply Mains.—Two, each 9,000 ft. long; one 14-in w. i. and cem., buried in cem.; one 16-in. c. i.

Distribution.—*Mains*, c. i., w. i. and cem., 35.3 miles, from and laid by Am. W. Wks. and Gas Pipe Co., now Ferris & Halladay, Jersey City, N. J. *Services*, lead. *Taps*, 4,494. *Meters*, 110. *Hydrants*, kind not given, 277.

Consumption, 1,400,000 galls. *Pressure*, 75 lbs.

Financial.—Cost, $509,884. Debt, $300,000: $150,000 at 6, $150,000 at 5%. Sinking fund, $13,496. Ann. op. exp., $12.145, including $6,693 for repairs. Ann. int., $16,500. Ann. rev.: consumers, $36,876; misc., $1,261; city, none.

Management.—Five Comrs. Prest., Horace A. Briggs. Secy., Timothy Kelly Supt., Junius A. Brand.

PAWCATUCK, *New London Co.* In town of Stonington, opposite Westerly, R. I., which see.

PLAINVILLE, *Hartford Co.* (Pop., 1,930; est., 2,000.) Is 14 miles west of Hartford. Manufactures clocks, carriages and woolen goods. Not incorp. No sewers or electric lights.

History.—Built in '84 by Plainville Water Co. Des. Engr., D. Goffe Phipps. Contrs., Conn. Patent Water Pipe Co. Both of New Haven.

Water Supply.—Surface water, by gravity from impounding reservoir.

Dam and Impounding Reservoir.—Cap., not given; area, 63 acres. Contrs., Chas. W. Blakeslee & Son, New Haven.

Distribution.—*Mains*, 8 to 4-in. w. i. and cem., 6¼ miles. *Services*, galv. i. *Taps*, 142. *Meters*, none. *Hydrants*, kind not given, 23.

Consumption, unknown. *Pressure*, 100 lbs.

Financial.—Cost, $30,300. Cap. stock, $30,000. No debt. Ann. op. exp., $100. Ann. rev.: consumers, $1,800; city, $100. Hydrant rental, $17.

Management.—Prest., Wm. L. Cowles. Secy. and Treas., E. C. Chapman. Supt., H. W. Higgins.

PLANTSVILLE, *Hartford Co.* See Southington.

PORTLAND, *Middlesex Co.* (Pop., town, 4,157; est., 4,200.) Is 14 miles south of Hartford. Has red sandstone quarries. Incorp. town. No sewers or electric lights.

History.—Built in '89 by Portland Water Co., under perpetual charter; put in operation about Oct. Engrs. and contrs., Wheeler & Parks, Boston, Mass.

Water Supply.—Somasick brook, by gravity from impounding reservoir.

Dam and Impounding Reservoir.—Cap., 40,000,000 galls.

Distribution.—*Mains*, 10 to 4-in. c. i., about 11 miles. *Services*, ¾-in. cnam. i. Pipe and specials from Warren Foundry and Machine Co., Phillipsburgh, N. J. *Hydrants*, Coffin, 70. *Valves*, Coffin.

Pressure, av., 100 lbs.

Financial.—Cost, $170,000. Cap. stock, $100,000. Bonded debt, $70,000. Int., 5%. Ann. rev.: contracts made with 3 quarries for total of $1,500. Hydrant rental, $30 each, in addition to exemption from taxes; 20-years contract.

Management.—Prest., Oliver Gildersleeve. Secy. and Treas., Henry Gildersleeve, Jr. Latest report by Wheeler & Parks; date, Aug., '89.

PUTNAM, *Windham Co.* (Pop., 5,827; est., 6,000.) On Quinnebaug river. Has various manufactories. No sewers. Has electric lights.

History.—Built in '85-6 by Putnam Water Co., under perpetual franchise. Engrs. and contrs., Wheeler & Parks, Boston, Mass.

Water Supply.—Little river, in Woodstock, Conn., pumping to stand pipe.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Worthington dup., water-power.

Stand-Pipe.—Cap., 240,000; 30 x 45 ft.; from E. Hodge & Co., E. Boston, Mass.

Distribution.—*Mains,* 10 to 4-in. c. i., 12.2 miles. *Services,* ¾-in. enam. w. i. Pipe and specials from Fox & Drummond, New York City; laid by Ferris & Halladay, Jersey City, N. J. *Taps,* 400. *Meters,* Crown, 10. *Hydrants,* Coffin, 61. *Valves,* Coffin.

Consumption, 180,000 galls. *Pressure,* av., 80 lbs.

Financial.—Cost, $150,000. Cap. stock, issued, $95,000. Bonded debt, $50,000; other debt, $3,000. Int., 5%. Ann. op. exp., including taxes, $1,850. Ann. int., $2,650 Ann. rev.: consumers, $3,200; city, $1,800. Hydrant rental, $30 each for 60; 20-years contract from Jan., '86.

Management.—Prest., L. H. Fuller, Putnam. Secy., Geo. E. Shaw, Putnam. Treas., Elbert Wheeler, 75 State St., Boston. Supt., C. D. Sharpe.

ROCKVILLE, *Tolland Co.* (Pop., 5,902; est., 6,800.) In Vernon township, 16 miles from Hartford. Manufactures envelopes, silk and woolen goods. No sewers or electric lights.

History.—Built in '47 by Rockville Aqueduct Co.; special charter taken out in '67.

Water Supply.—Shenipsit lake, by gravity. Lake has an area of 524 acres; 280 ft. above lowest part of town, and level is raised by dam.

Dam.—Granite in cem., 50 ft. long.

Distribution.—*Mains,* 14 to 2-in., c. i., 10 miles; originally w. i. and cem., but proving unsatisfactory were changed. *Services,* lead. *Taps,* 600. *Meters,* 1. *Hydrants,* Chapman, 60. *Valves,* Chapman.

Consumption, not given. *Pressure:* Ordinary, 75 lbs. Fire, 150 lbs.

Financial.—Cost, $60,000. Cap. stock, $22,000. No debt. Ann. op. exp., withheld, est., $700. Ann. rev.: consumers, withheld, est., $12,000; city, none. Hydrant rental, free.

Management.—Prest., Geo. Maxwell. Secy. and Treas., J. C. Hammond, Jr. Supt., Chas. W. Wood.

SHARON, *Litchfield Co.* (Pop., 2,580; est., 2,600.) Not incorp. No sewers or electric lights.

History.—Built in '88 by Sharon Water Co. Des. Engr., I. N. Bartram. Const. Engr., H. C. Rawley.

Water Supply.—A mountain brook, by gravity from impounding and distributing reservoir. Drainage area, "several miles."

Dam and Reservoir.—Cap., 1,500,000 galls. Dam of stone in cem., with gravel and "bottom soil" bank on lower side; founded on blue clay, on slope; 160 ft. long, 15 ft. high; stone part 2 ft. wide on top, about 4 at bottom. *Spillway:* 12 ft. from end of dam, 15 ft. wide, 2 ft. deep; lined with masonry; free. *Discharge-pipe:* 8-in. Dam "very tight." Built in '88. Engr., T. Seward, Norwalk. No contrs. Cost, $2,500.

Distribution.—*Mains,* 1¾ miles; steel, lined with cement, coated with asphalt, made by Norwalk Water Pipe Co., Norwalk. *Taps,* 50. *Meters,* none. *Hydrants,* Ludlow, 14.

Consumption, not given. *Pressure,* 70 lbs.

Financial.—Cost, $14,500. Debt., $2,500. Int., 6%. Ann. op. exp., $75. Ann. rev.: consumers, $475.

Management.—Prest., Milo B. Richardson, Lime Rock. Secy. and Treas., Willard Baker. Supt., I. N. Bartram.

SHELTON, *Fairfield Co.* (Pop., 1,362; est., 2,500.) A suburban borough of Birmingham. Has sewers and electric lights.

History.—Built in '81 by Shelton Water Co. Engr., D. S. Brinsmade.

Water Supply.—Curtis brook, by gravity from impounding and distributing reservoirs, 1 mile apart, formed by dams across stream.

Dam and Impounding Reservoir.—Cap., 50,000,000 galls.; area, 18 acres. Dam of earth, with sheet-piling and clay puddling.

Dam and Distributing Reservoir.—Cap., 2,750,000 galls.; area, ¾ acres; ½ mile from, 230 ft. above, town. Dam of stone, grouted, 110 ft. long, 25 ft. high, 4 ft. thick on top, 18 at bottom. Wing-wall, 60 ft. long. *Spillway:* in dam, 40 ft. wide, 4 ft. deep. Cost, $5,435.

Supply Main.—C. i., 12-in. 2,494 ft. long.

Distribution.—*Mains*, 8 to 4-in., c. i. 5 miles; laid by Inman Bros., N. Y. City. *Services*, galv. i. *Taps*, withheld, est., 150. *Meters*, 1. *Hydrants*, Mathews, 35. *Valves*, Ludlow.

Consumption, 225,000 galls. *Pressure*, 90 lbs.

Financial.—Cost, $36,000. Cap. stock, $25,000. Debt (in '88), $7,000. Int., 5 %. Ann. op. exp., $1,000. Ann. rev.: consumers (in '87), $3,000; city, $1,050. Hydrant rental, $30.

Management.—Prest., D. W. Plumb. Secy., Treas. and Supt., D. S. Brinsmade. Birmingham, Conn.

SIMSBURY, *Hartford Co.* (Pop., est., 500.)

History.—Built fall of '73 by Simsbury Water Co.

Water Supply.—Small streams, by gravity from reservoir.

Dam and Reservoir.—Cap., not given; area, 1 acre. Dam 8 ft. long, 5 ft. high.

Supply Main.—Iron, 6-in., 1½ miles long.

Distribution.—*Mains*, including supply, 2 miles. *Takers*, 50. *Fire-plugs*, 10.

Financial.—Cost, original, $13,000. Cap. stock, $13,000. Ann. op. exp., av., $25. Ann. rev.: consumers, withheld, est., $800.

Management.—Not given.

SOUTHINGTON, *Hartford Co.* (Pop., 5,411; est., 6,000.) On Quinnipiac river, on rolling ground, in valley between rocky hills. Manufactures carriages, tacks, wood screws, silver plated ware, pocket cutlery and all sorts of hardware. Settled in 1690. Incorp. a town in 1779. No sewers. Has electric lights.

History.—Built in 83-4 by Southington Water Co. Engr., T. H. McKenzie, Southington. Consult. Engr., J. J. R. Croes, New York City. Supplies Plantsville as a part of system.

Water Supply.—Humiston's brook, by gravity from impounding and distributing reservoir, ¾ miles apart. Brook is a mountain stream; drainage area, about 2½ sq. m.; av. dy. flow in '83, 4,300,000 galls.

Dams and Reservoirs.—*Impounding:* cap., 60,000,000 galls. Dam of earth, with heart-wall; 525 ft. long, 30 ft. high, 16 ft. wide on top; inner slope, 2 to 1, riprapped, outer, 1½ to 1. *Heart-wall:* masonry and puddle. *Discharge-pipe:* c. i., 20-in., 140 ft. long.

Distributing: cap., 4,000,000 galls.; 225 ft. below impounding, 230 ft. above most of town. Dam of stone, backed with earth at slope of 1½ to 1; 170 ft. long, 20 ft. high, 5 ft. thick at level of overfall, 14 at base. *Spillway:* 40 ft. long. *Discharge-pipes:* waste and supply, size not given.

Supply Main.—C. i., 10-in., 2½ miles long.

Distribution.—*Mains*, c. i., 13 miles. *Services*, galv. 1. *Taps*, 500. *Meters*, none. *Hydrants*, Ludlow, 72. *Valves*, Ludlow.

Consumption, 500,000 galls. *Pressure*, 98 lbs.

Financial.—Cost, $93,000. Cap. stock, $60,000. Bonded debt, $32,200. Int., 5%. Ann. op. exp., withheld, est., $1,000. Ann. rev.: total, $6,500. Hydrant rental, $20 and $25.

Management.—Prest., J. B. Savage. Secy., Treas. and Supt., T. H. McKenzie.

SOUTH NORWALK, *Fairfield Co.* (Pop., 3,726; est., 4,500.) On Long Island Sound, at mouth of Norwalk river, on rolling ground. Engaged in oyster gathering and manufacturing. Has sewers and electric lights.

History.—Built in '75 by town. Engr., Wm. B. Rider, South Norwalk. In '89, city voted to extend main across harbor to East Norwalk; est. cost, $12,500.

Water Supply.—Surface water, by gravity from two impounding reservoirs on stream, 5 miles from, 223 ft. above, city; drainage area, 5 sq. m.

Dams and Reservoirs.—Combined cap., 166,000,000 galls. Each dam of earth, with heart-wall of rubble masonry in cement. *Dam, No.* 1: cap., not given; area, 17 acres; 207 ft. long, 31 ft. high. Cost, $6,086. *Dam, No.* 2: cap., not given; area, 4 acres; 205 ft. long, 15 ft. high; inner slope, 2 to 1, outer, 1½ to 1. Cost, $7,536.

New Dam.—Between Nos. 1 and 2. Engr., Wm. B. Rider, S. Norwalk. Contr., Adam Miller, Saratoga, N. Y. Under construction in '89.

Filter.—Charcoal and sponge; 4 x 4 x 8 ft., at lower reservoir; cleaned twice a year.

Supply Mains.—*Old:* c. i., 12-in. about 4¾ miles long. *New:* 18-in., from new reservoir.

Distribution.—*Mains* (in '87), 12 to 4-in., c. i., 14 miles. *Services*, w. i., lead, brass. *Taps* (in '87) 451. *Meters* (in '87), 24. *Hydrants*, Mathews, 70. *Valves*, Ludlow.

Consumption, not given. *Pressure*, 70 lbs.

Financial.—Cost, $124,902. Bonded debt, $38,000: $70,000 at 6, and $18,000 at 4%. Ann. op. exp., $1,200. Ann. rev.: consumers, $11,000; city, $2,000. Hydrant rental, $40.

Management.—Comrs. Chn., Saml. Raymond. Secy., Jacob M. Layton. Supt. M. M. Norton.

STAFFORD SPRINGS, *Tolland Co.* (Pop., 2,081: est., 3000.) In Stafford township, on Willimantic river. Has woolen, cotton and iron manufactories. Incorp. a borough. Partially sewered.

History.—Built in '87 by Stafford Springs Water Co., under perpetual charter. Engrs., contrs. and principal stockholders, Goodhue & Birnie, Springfield, Mass.

Water Supply.—Roaring brook, by gravity from storage and distributing reservoirs about 5 miles from, 285 ft. above, village.

Reservoirs.—Combined cap., 4,500,000 galls. *Storage:* cap., 4,000,000 galls. *Distributing:* cap., 5,000,000 galls.

Distribution.—*Mains*, 10½ miles. *Taps*, 150. *Meters*, 30. *Hydrants*, 32.

Consumption, not given. *Pressure:* Ordinary, 128 lbs.

Financial.—Cost, withheld, est., $75,000. Cap. stock, $35,000. Bonds, $35,000. Int., not given. Ann. op. exp., $500. Ann. rev.: consumers, withheld, est., $3,000; city $900. Hydrant rental, $30 each for 30.

Management.—Prest., Wm. Birnie, Springfield. Secy., J. F. Chamberlain. Treas., Thos. N. Birnie, Springfield. Supt., Anthony Adams.

STAMFORD, *Fairfield Co.* (Pop., 11,297; est., 16,000.) On Long Island Sound, on quite level ground. Has extensive manufactories. Incorp. Has sewers and electric lights.

History.—Built in '60 by Stamford Water Co. Des. Engr., H. G. Scofield, Bridgeport. Const. Engr., Geo. E. Whitney. Contrs., Conn. Patent Water Pipe Co., New Haven, and R. D. Wood & Co., Philadelphia, Pa. In '89, State Inspector B. S. Hull, of Bridgeport, inspected one of the dams at request of Co.; it was found in leaky condition, and rebuilt and raised 4 or 5 ft. under direction of Mr. Hull.

Water Supply.—Trinity lake, by gravity, to and from Simsbury distributing reservoir. Lake has cap. of 300,000,000 galls.; fed by springs, entirely surrounded by hills; 14 miles from Stamford, in town of Poundridge, N. Y. Water from lake flows in natural stream for 7 miles to Coxe's dam, thence as below.

Coxe's Dam.—No data.

Conduit.—Diam., 16 and 12 ins.; length, 4 miles.

Simsbury Reservoir.—Cap., 6,500,000 galls.; in excavation and embankment, 170 ft. above tide-water; 2 miles from town.

Supply Main.—Diam., 16 ins.; length, about 2 miles.

Distribution.—*Mains*, 15 to 4-in. c. i. w. l. and cem., 34 miles. *Services*, lead. *Taps*, 1,173. *Meters*, Thompson, National, 4. *Hydrants*, Ludlow, 86. *Valves*, Ludlow.

Consumption, 1,000,000 galls. *Pressure*, 50 lbs.

Financial.—Cost, $333,218. Cap. stock, $200,000. Bonded debt, $70,000; first mortgage. Int., 5%. Ann. op. exp., withheld, est., $4,000. Ann. int., $3,500. Ann. rev.: consumers, $25,568; city, $2,000. Hydrant rental, $20.

Management.—Prest., Jas. B. Williams. V.-Prest., A. J. Hatch. Secy., Walter Ferguson. Treas., G. A. Hoyt. Supt., Geo. E. Whitney.

STONINGTON, *New London Co.* (Pop. of town, 7,355; est., not given.) On Long Island Sound. Has good harbor, and is engaged in trade and manufacturing. Incorp. No sewers or electric lights.

FIRST SUPPLY.

General Description.—A small private gravity supply for railroad and steamboat use was introduced in '65, consisting of 4 miles of pipe, 12 taps and 9 hydrants.

MYSTIC VALLEY WATER CO.'S PLANT.

History.—Built in '88, under perpetual franchise. Supplies Stonington borough and town and Mystic fire district, all in town of Stonington. Engrs. and Contrs., Wheeler & Parks, Boston, Mass.

Water Supply.—Mistuxet brook, pumping from storage to distributing reservoir.

Storage Reservoir.—No data.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; Deane; 750,000 water-power, 1,250,000 comp. *Water-wheel:* Hercules turbine. *Boiler:* E. Hodge & Co., E. Boston, Mass.

Dstributing Reservoir.—Cap., 2,000,000 galls. Engrs. and Contrs., see History.

Distribution.—(Aug., '89) *Mains*, 12 to 4-in. c. i., 13 miles. *Services*, ¾-in. enam. i. Pipe from Warren Foundry & Machine Co., Phillipsburgh, N. J.; laid by C. H. Eglee, Flushing, N. Y. Specials from Builders' Iron Foundry, Providence, R. I. *Taps*, 175. *Meters*, Crown, Gem, number not given. *Hydrants*, Coffin, 92 public, 10 private. *Valves*, Coffin.

Consumption, 200,000 galls. *Pressure*, 75 lbs.

Financial.—(Aug., '89.) Cost, $240,000. Bonded debt, $100,000. Int., 5%. Ann. op. exp., $1,200. Ann. int., $5,000. Ann rev.: consumers, $4,200; city, $3,180. Hydrant rental: Stonington, $35.70, two free; Mystic, $35; 20-years contract.

Management.—Prest., T. E. Packer. Secy., Geo. E. Grinnell. Both of Mystic Bridge. Treas., D. B. Spalding, Stonington. Supt., A. G. Watrous, Mystic Bridge.

THOMASTON, *Litchfield Co.* (Pop., 3,225; est., 4,000.) On irregular ground. Has rolling mills and manufactures clocks. No sewers. Has electric lights.

History.—Built in '80 by Thomaston Water Co. Engr., Wm. B. Rider, South Norwalk. Contrs., C. T. Leonard & Son, South Norwalk.

Water Supply.—Springs, by gravity from impounding reservoir.

Dam and Reservoir.—Cap., 65,000,000 galls.; area, 11 acres. No other data.

Distribution.—*Mains*, 12 to 4-in. c. i., 8 miles. *Services*, w. i. *Taps*, 310. *Meters*, 1. *Hydrants*, kind not given, 36.

Consumption, unknown. *Pressure*, 126 lbs.

Financial.—Cost, $42,000. Cap. stock, $36,000. Debt, none. Int., 5%. Ann. op. exp., $400. Ann. rev.: consumers, $3,000; city, $600 Hydrant rental, $16.67.

Management.—Prest., Aaron Thomas. Treas., A. J. Hine. Secy. and Supt., W. T. Woodruff.

THOMPSONVILLE, *Hartford Co.* (Pop., 3,794; est., 4,000.) On Connecticut river. Engaged in carpet and other manufacturing. No sewers or electric lights.

History.—Built in '85 by Thompsonville Water Co. Engrs. and contrs., Goodhue & Birnie, Springfield, Mass., who control works. In '89 works were extended 9 miles to supply Ware House Point.

Water Supply.—Springs, pumping to tank.

Pumping Machinery.—Dy. cap., 900,000 galls.; Deane comp., cond.

Tank.—Cap., 329,000 galls.; 40x35 ft., 15 ft. added in Dec., '89; Contr., R. F. Hawkins, Springfield.

Distribution.—*Mains*, w. i. and cem., 10 miles. *Services*, w. i. and cem. *Taps*, 556. *Meters*, none. *Hydrants*, 20.

Consumption, 150,000 galls. *Pressure:* Ordinary, 65 lbs. Fire, 100 lbs.

Financial.—Cost, $60,000. Cap. stock, $50,000. No debt. Ann. op. exp., withheld, est., $1,200. Ann. rev. (in '87): consumers, $4,600; city, $1,000. Hydrant rental, $50.

Management.—Prest., Chas. H. Briscoe. Secy. and Treas., Thos. N. Birnie, Springfield, Mass., Supt., H. R. Cooper.

TORRINGTON, *Litchfield Co.* (Pop., 3,327; est., 3,900.) On Naugatuck river, in broken and rocky country. Has some manufactories. Incorp. a borough. Has sewers and electric lights.

History.—Built in '78 by Torrington Water Co. Engr., Wm. B. Rider, So. Norwalk.

Water Supply.—Surface water, by gravity from impounding reservoirs on stream; drainage area, 8 sq. m. Additional reservoir projected.

Dams and Reservoirs.—*No.* 1: cap., 18,000,000 galls.; area, 5½ acres; dam of earth, 234 ft. long, 20 ft. high, with masonry heart-wall 8 ft. wide at bottom and 3 ft. at top. *No.* 2: cap., 53,000,000 galls.; area, 19½ acres. Dam not described.

Filter.—Charcoal and sponge.

Distribution.—*Mains*, 14 to 4-in. c. i., 8 miles. *Services*, w. i. *Taps*, 439. *Meters*, 1. *Hydrants*, Mathews, 24. *Valves*, Ludlow. *Close of '80*: Mains, 5 miles. Taps, 131. Meters, none. Hydrants, 24.

Consumption, 1,000,000 galls. *Pressure*, 70 lbs.

Financial.—Cost, $52,500. Cap. stock, $40,000. No debt. Ann. op. exp., $1,200. Ann. rev.: consumers, $6,500; city, $360. Hydrant rental, $15. Cost, close of '80, $31,000. Rev., in '80, $1,800.

Management.—Prest., I. W. Brooks. Secy. and Treas., Chas. L. McNeil. Supt., O. R. Fyler.

WALLINGFORD, *New Haven Co.* (Pop., 3,017; est., 5,000.) On hilly ground on Quinnipiac river. Engaged in manufacturing. Incorp. a borough in '68. Has sewers. No electric lights.

History.—Built in '82 by borough. Const. Engr., Jno. Osborne. Contr., Wm. C. McClallan, deceased. Sub-contrs., Inman Bros., New York City.

Water Supply.—Lake Pistapaugh, by gravity. Lake is 4½ miles from, and 245 ft. above, centre of borough, and 315 to 330 ft. above manufacturing portions. Area, 136 acres; drainage area, about ½ sq. m.; drainage of additional ¾ sq. m. can be diverted into lake.

Intake.—Water taken 800 ft. from shore, at depth of 11 ft., through 18-in. stoneware pipe to gate-chamber.

Supply Main.—C. i., at first 12-in., afterward reduced to 10 and 8-in., about 4 miles long.

Tunnel.—Is 1,000 ft. long, 30 ft. below surface; for supply main.

Distribution.—*Mains*, c. i., 17 miles. *Services*, galv. i. *Taps*, 630. *Meters*, none. *Hydrants*, Chapman, 70.

Consumption, 300,000 galls. *Pressure*, 100 to 130 lbs.

Financial.—Cost, $107,684. Bonded debt, $105,000. Int., 4 %. Sinking fund, none. Ann. op. exp., $822. Ann. int., $4,200. Ann. rev.: consumers, $5,695; city, $1,050. Hydrant rental, $15.

Management.—Three Comrs. Supt., W. J. Morse.

WARE HOUSE POINT, *Hartford Co.* See Thompsonville.

WATERBURY, *New Haven Co.* (Pop., 17,806; est., 30,000.) On Connecticut river, surrounded by hills. Has extensive manufacturies of all kinds of brass goods. Settled in 1667; incorp. a city in '53. Has sewers and electric lights.

History.—Built in '68 by city. Const. Engr., Nelson J. Welton. Contr., Geo. H. Norman, Newport, R. I.

Water Supply.—Springs and surface water, by gravity, from impounding and distributing reservoirs; also emergency supply by pumping from Mad river. See note below.

Dams and Reservoirs.—Combined cap., 185,000,000 galls. *East Monntain Brook Storage:* Cap., 100,000,000 galls.; area, about 35 acres. Dam of sand, gravel and loam, in 3-in. layers, with heart-wall; founded on gravel and rock, 360 ft. long, 30 ft. high, water 5 ft. from top; 14 ft. wide at top, 119 at base; inner slope 2 to 1, paved 1 ft. or more thick, has heavy foot-wall; outer slope, 1½ to 1, sodded. *Heart-wall:* sand and clayey loam, puddled, 10 ft. thick at bottom, 4 at top. *Spillway:* at east end, 5 ft. deep in earth, not lined with plank or masonry, free; level for 50 ft. *Discharge-pipes:* two, 12 and 20-in.; slope, slight. Dam does not leak badly. Built in '67. Const. Engr., N. J. Welton, Waterbury. Contrs., Martin & Shay, deceased. Cost, $15,000.

East Mountain Brook Distributing: cap., 8,000,000 galls.; area, 3 acres; ½ mile from, 175 ft. below, above-described storage reservoir, 225 ft. above town. Dam of sand, gravel and loam in 3-in. layers, with heart wall; founded on gravel and rock; 262 ft. long, 25 ft. high, water 5 ft. from top; 14 ft. wide at top, 102 at base; inner slope, 2 to 1, paved 1 ft. or more thick; outer, 1½ to 1, soddod. *Heart-wall:* sand and clayey loam, puddled, 10 ft. thick at base, 10 at top. *Spillway:* at west end, 5 ft. deep, partly in rock, not lined with plank or masonry, free; level for 50 ft. *Discharge-pipes:* two, 12 and 16-in.; slope, slight. Dam does not leak badly. Built in '67. Const. Engr., N. J. Welton, Waterbury. Contrs., Martin & Shay, deceased. Cost, $8,000.

Prospect Storage Reservoir: cap., 67,000,000 galls.; area, 20 acres; 3,500 ft. from first storage reservoir, but on another stream. Dam not described. Built in '80.

Cooke Street: cap., 10,000,000 galls., area, 2 acres. No other data.

Conduit and Supply Mains.—A 12-in. pipe, 3,500 ft. long connects Prospect with East Mountain storage reservoir. Supply main from East Mountain reservoir is about two miles long; originally 12-in. cem.; in '87 all but first 1,500 ft. was replaced with 3,486 ft. of 16 and 5,600 ft. of 18-in. c. i. pipe, and it was proposed to replace the remaining 1,500 ft. of cem. pipe with 16-in. c. i. The above change increased av. pressure 20 lbs. New pipe from Warren Foundry & Machine Co. Phillipsburgh, N. J.

Pumping Machinery.—Dy. cap. 1,000,000 galls.; Worthington; for emergency; not necessary to use in '89.

Distribution.—*Mains*, c. i., w. i. and cem., 36 miles. *Services*, galv. i. *Taps*, 3,056. *Meters*, Worthington, Crown, Union rotary, 143. *Hydrants*, Holyoke, 238. *Valves*, Whittier. *Pressure-recording gauge*, Edson.

Consumption, 1,500,000 galls. *Pressure*, 75 to 90 lbs.

Financial.—Cost, $493,011. Bonded debt, $265,000: $190,000 at 7, $75,000 at 4½%. Sinking fund, $62,245. Ann. op. exp., $13,385. Ann. int., $16,675. Ann. rev.: consumers, $49,309; city, $4,020. Hydrant rental, $20.

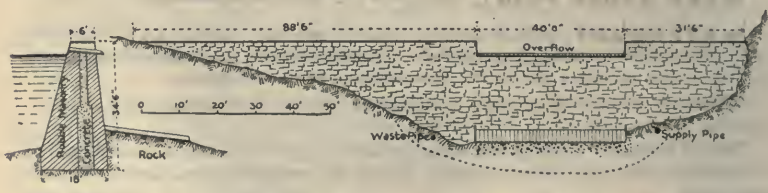
Management.—Five Comrs. Pres. and Supt., Nelson J. Welton. Engrs. to Board, Welton & Bonnett.

NOTE.—Surveys and estimates have been made for a new 400,000,000-gall. reservoir on Hop brook, in Watertown, 5 miles from, and 325 ft. above, Center square. This would involve a dam 600 ft. long, 35 ft. high, containing 40,000 cu. yds. of masonry and earthwork, and a pipe line to city, 26,500 ft. long in 3 nearly equal sections, having 24, 20 and 18-in. pipe, according to grade. Estimated cost of dam and pipe is $230,000, not including land or right of way.

WEST HAVEN, *New Haven Co.* (Pop., 1,975; est., 4,000.) A borough in township of Orange, 2 miles from New Haven. Has numerous manufactories. Incorp. No sewers. Has electric lights.

History.—Built in '83 by West Haven Water Co. Engr., D. Goffe Phipps. Contrs., Conn. Patent Water Pipe Co. All of New Haven. A new dam has been proposed, similar to the one described below.

Water Supply.—Cove river, pumping to reservoir.



Cross-Section and Elevation of Cove River Dam, West Haven, Conn.

Cove River Dam and Reservoir.—Cap., not given; area, 5 acres. Dam of rubble masonry, founded on rock, with heart-wall; 160 ft. long, about 28 ft. high, above natural surface. *Heart-wall:* concrete, 4 ft. thick for about 17 ft., then 2 ft. *Discharge-pipes:* two, each 12-in., waste and discharge. See accompanying section and elevation. Dam does not leak. Built in '84. Engrs. and Contrs., see History. Cost, $3,700.

Pumping Machinery.—Dy. cap., 500,000 galls.; Worthington.

Reservoir.—Cap., 1,000,000 galls.

Distribution.—*Mains*, w. i. and cem., 11.3 miles. *Services*, galv. i. *Taps*, 35[illegible]. *Meters*, 7. *Hydrants*, Ludlow, 13. *Valves*, 78.

Consumption, unknown. *Pressure*, 43 lbs.

Financial.—Cost, $73,000. Cap. stock, $100,000. No debt. Ann. op. exp., withheld, est., $1,000. Ann. rev.: consumers, withheld, est., $700; city, $320. Hydrant rental, $20.

Management.—Prest., D. Goffe Phipps, New Haven. Supt., E. H. Phipps.

WILLIMANTIC, *Windham Co.* (Pop. 6,608; est., 10,000. In Windham township, on Willimantic river. Manufactures silk, cotton, and other goods. Incorp. Has sewers and electric lights.

History.—Built in '85-6 by city. Engr., J. T. Fanning, Minneapolis, Minn.

Water Supply.—River Natchaug, pumping to reservoir.

Pumping Machinery.—Dy. cap., 3,500,000 galls.; a 1,500,000 pump, made by R. D. Wood & Co., Philadelphia, Pa.; other, not given.

Reservoir.—Cap., 5,000,000 galls.

Distribution.—*Mains*, 14 to 6-in., c. i., 14 miles. *Services*, lead. *Taps*, 791. *Meters*, 39. *Hydrants*, Mathews, 141.

Consumption, 192,000 galls. *Pressure*, 90 lbs.

Financial.—Cost, about $237,000. Debt, $220,000; bonds, $200,000 at 4; floating, $20,000, at 5%. Ann. op. exp., about $1,750. Ann. int., $8,250. Ann. rev.: consumers, about $5,700; city, $4,360. Hydrant rental, $30.

Management.—Three Comrs. Prest., S. C. Smith. Secy., W. G. Morrison. Treas., H. E Remington. Supt., H. S. Monlton.

WINDSOR, *Hartford Co.* (Pop., 3,056.) Manufacturing town. Incorp. a town. Has sewers.

History.—Built in '69-70 by N. Sidney Hayden; known as Windsor Water Co.

Water Supply.—Springs, by gravity.

Reservoir.- Cap. est., 8,000,000 galls., 300 x 500 ft., x 10 ft. deep.

Supply Main.—Iron, 600 ft. of 8, 1 mile of 6-in.

Distribution.—*Mains*, 6-in. iron, including supply, 3.1 miles. *Taps*, about 30. *Hydrants*, 12.

Consumption, 15,000 galls. *Pressure*, 60 ft. head.

Financial.—Cost, $10,000. Ann. op. exp., about $25. Ann. rev.: consumers, not given; est., $500.

Management.—Owner, N. Sidney Hayden.

WINDSOR LOCKS, *Hartford Co.* (Pop., town, 2,332; est., 3,000.) Is 12 miles north of Hartford. Has various manufactories. Incorp. No sewers. Has electric lights.

History.—Built in '89 by Windsor Locks Water Co.; put in operation about Dec. 1. Engrs., Dunham & Paine, Cleveland, O. Supt. of construction, C. T. Baudle, Conneaut, O. Contrs., S. P. Townsend & Son, Hartford.

Water Supply.—English brook, 2 miles distant, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., not given; Worthington water-power.

Stand-Pipe.—Cap., 235,000 galls.; 20 x 100 ft.; on Coogan hill; from R. F. Hawkins, Springfield, Mass.

Distribution.—*Mains*, 10 to 4-in. c. i., about 7 miles. *Services*, iron. *Hydrants*, Ludlow, about 30.

Financial.—Cost, est., $49,000; cap. stock, authorized, $80,000. Bonded debt, $40,000. Int., 5%. Hydrant rental, withheld.

Management.—Prest., E. D. Coogan. Secy., J. W. Johnson, Treas., A. L. Fennessy, Springfield, Mass. Supt., — Egan. Main report by A. L. Fennessy, June 6, '89; later data from J. W. Johnson, Feb. 28, '90.

WINSTED, *Litchfield Co.* (Pop., 4,279; est., 6,000.) Consists of two villages on Mad river, connected by a winding street, 3 miles long, on which is business portion of town, residences being on hillside further back. Settled in 1770. Incorp. a borough. Partially sewered. Has electric lights.

History.—Built in '62 by borough. Engr., A. Chamberlain.

Water Supply.—From lake by gravity. Lake is about 1 mile wide and 3 miles long. Original supply was from two natural ponds, one of 390 acres area, increased to 500 acres by earth dam 4 ft. high, and one of 100 acres area. In '74, two waste-weirs of masonry, with concrete overflows, were built. Supply taken from lake about ½ mile from and 220 ft. above town.

Distribution.—*Mains*, c. i., w. i. and cem., 11½ miles; from Ferris & Halladay, Jersey City, N. J. *Services*, galv. i. *Taps* (in '87), 744. *Meters*, none. *Hydrants*, Holyoke, partly, 97.

Consumption, unknown. *Pressure*, 55 lbs.

Financial.—Cost, $128,656. Bonded debt, $25,000. Int., 4 and 5%. Sinking fund, $1,000. Ann. op. exp., about $800. Ann. rev.: consumers, $6,263; misc., $100; city, none. First cost, $25,000.

Management.—Three Comrs. Supt., E. E. Culver.

Water-Works Projected with Fair Prospects of Construction.

EAST HARTFORD, *Hartford Co.* (Pop., 3,500; est., 4,000.) Manufactures paper and carriages. Incorp. a town.

Proposed Works.—East Hartford Water Co. made proposition to fire district Feb. 7, '90; result not stated. Co. chartered in '87, organized in '89, hopes to build in '90. Prest., E. J. McKnight. Secy., A. C. Liekert. Treas, L. S. Forbes. Latest report from Prest.; date, about Feb. 28, '90.

Water-Works Projects Reported in '89 and '90, but now Indefinite.

New Hartford, Litchfield Co. *Newtown*, Fairfield Co.; see MANUAL for '88, p. 88. *Westport*, Fairfield Co.

GROUP 2. Middle States.—Water-Works Completed, in Process of Construction or Projected, in New York, New Jersey, Pennsylvania, Delaware, Maryland and District of Columbia.

NEW YORK.

Water-Works Completed or in Process of Construction.

ADAMS, *Jefferson Co.* (Pop., 1,250; est., 1,500.) In farming country; has several manufactories. Incorp. No sewers. Has electric lights.

History.—Built in '86 by Adams Water-Works Co. Engrs. and Contrs., Moffett, Hodgkins & Clarke, Syracuse.

Water Supply.—Springs, pumping to stand-pipe, with direct pumping in case of fire.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Worthington.

Stand-Pipe.—Cap., 55,000 galls.; 15 x 40 ft.; w. i.; on elevation 160 ft. above business part of town.

Distribution.—*Mains*, c. i., 3½ miles. *Services*, galv. i. *Taps*, 79. *Meters*, 3. *Hydrants*, Mathews, 25.

Consumption, 31,249 galls. *Pressure:* Ordinary, 44 lbs. Fire, 120 lbs.

Financial.—Cost, $30,000. Debt, $25,000. Int., 6%. Ann. op. exp., $1,000. Ann. rev.: consumers, $2,100; city, $1,182.

Management.—Supt., I. W. Payne.

ADDISON, *Steuben Co.* (Pop., 1,596; est., 3,000.) On Canisteo river. In agricultural and lumbering district. Has manufactories. Incorp. village. No sewers or electric lights.

History.—Built in '89 by Addison Water Co.; put in operation Jan. 1, '90 Engr., Chas. C. Hopkins, Rome.

Water Supply.—Source not given, by pumping.

Reservoir.—Cap., 8,000,000 galls. Contr., Francis Leonard, So. Norwalk, Conn. Contract price, $6,500.

Pumping Machinery.—Dy. cap., 750,000 galls.; Worthington.

Distribution.—*Mains*, c. i., 3 miles. Pipe and specials from R. D. Wood & Co., Philadelphia, Pa.; trenching and pipe-laying done by Francis Leonard, So. Norwalk, Conn. *Hydrants*, Ludlow, 60. *Valves*, Ludlow.

Pressure, 90 lbs.

Financial.—Cost, $40,000. Cap. stock: authorized, $40,000; paid in, $10,000. Bonded debt, $40,000. Bonds authorized, $40,000. Int., 6%. Hydrant rental, $25.

Management.—Prest., E. M. Welles. Secy., G. C. Howard. Treas., W. T. Moran. Supt., C. A. Brewster. Date latest report, Feb. 28, '90.

ALBANY, *Albany Co.* (Pop., 90,758; est., 94,000.) On Hudson river, extending for few hundred feet from river over alluvial plain, then rising quite abruptly to plateau 150 to 220 ft. high. Slope towards river is divided by 3 or 4 valleys worn by former streams in clay bluff. Settled in 1616; incorp. city in 1686.

History.—Small gravity works built in last century by a company supplied that part of city below and including Pearl street; new gravity works built by city in '51, reinforced by pumping in '72, supplemented by pumping from Hudson river in '73; new system by pumping from driven wells constructed in '88-9.

In '13 pop. was 11,000. Water was then brought to city from small streams through 3 miles of 6-in. c. i. pipe. Three tons of pipe were laid, some of which is still in use after longer service than is recorded of any other c. i. pipe in the U. S.; it is claimed that this was first c. i. pipe made in country. Two straight pieces and one branch of this pipe are in possession of Am. Soc. C. E., N. Y. City.

In '30 Maezlandt Kill supply was introduced, water being taken from stream about 2 miles north of city, from impounding reservoir formed by a dam, and called Tivoli lake.

In '51, pop. being about 50,000, city bought Co.'s works, and extended them. Engr., Wm. J. McAlpine, deceased. In '73 plan to take water from Hudson river was adopted. Engr., I. C. Chesbrough. Consult. Engr., Jas. P. Kirkwood, deceased. Chemist, Prof. C. F. Chandler.

Water Supply.—Patroon creek, by gravity, and driven wells, by pumping.

Supply from Patroon creek in '51 was first impounded in reservoir called Rensselaer lake, then conveyed to Bleecker distribution reservoir. In '73, timber having been cut from drainage area of creek, lake having been partially filled by sand driven into it during storms, and pop. having increased, supply was insufficient and of bad quality. A 1,000,000-gall. Worthington pump was then erected and water pumped from Tivoli lake into Bleecker reservoir, and in following year second pump forced water into Rensselaer lake.

In '73 supply was further increased by pumping from Hudson river to Bleecker reservoir, and in '75 high service reservoir was built on Prospect hill and supplied by pumping from Bleecker reservoir.

Tivoli lake supplies low service, Bleecker reservoir middle service, Prospect hill reservoir high service; these reservoirs are 144, 246 and 300 ft., respectively, above tide. Maezlandt Kill supplies a portion of North Albany. These three reservoirs and Maezlandt Kill were used by Co. previous to purchase of works by city in '51.

The new driven well supply was to furnish at least 15,000,000 galls. daily. September, '89, there had been driven 390 of these wells, each 2 ins. in diam., the first 225, at least, located along 5 lines of pipe connecting with receiving tank. Each well is connected with main by a 3-in. pipe; mains are 16, 18 and 20 ins. in diam., and tank 12 ft. in diam by 12 ft. deep. On pipe leading from each well there is a 3-in. Eddy valve. Temperature of water is 48°, which is said to be lowest attained from driven wells. Water will be pumped from receiving tank to 3 reservoirs. Wells were put in by Wm. D. Andrews & Bro., Brooklyn, under their patents, and reservoir by Crawford & Valentine, Brooklyn. Engr. for reservoirs and their connection with wells, J. M de Varona, Brooklyn.

Dams and Reservoirs.—*Rensselaer lake:* cap. about 120,000,000 galls.; area, 39 acres; dam of earth, 31 ft. high, carried 8 ft. above water-line, 10 ft. wide at top; outer slope 2 to 1; inner, 1½ to 1. *Heart-wall:* puddled clay, 8 ft. thick at top, increasing 4 ft. for each 10 ft. in depth.

Bleecker hill distributing reservoir: cap., 30,000,000 galls.; in excavation and embankment, 500 x 570 ft.; inner slopes originally paved with brick; in '76 a part of the top of slopes was repaved with stone and cement. *Tivoli reservoir:* cap., 30,000,000 galls.; area, 20 acres; dam, earth, 25 ft. high. *Prospect hill high service reservoir:* cap., 6,743,378 galls.; area, 1¾ acres; depth, 14 ft.; has banks of sand, rolled in layers and covered with soil and sodded; inner slopes, 1½ to 1; outer, 2 to 1. Bottom has 6 ins. of puddle lining, then 6 ins. of concrete, then 18 ins. of puddle, and finally a covering of brick and cem. For 10 ft. from bottom inner slopes have 6-in. layer of puddle and concrete, then 2½ ft. of puddle and 10 ins. of brick and cem.; from this point to 5 ft. above water-line is a paving of stone and cem., backed by 3 ft. of gravel placed on 3 ft of puddle and concrete.

Conduits: connecting Rensselaer lake with Bleecker reservoir, 21,090 ft. long; brick, 8 ins. thick; oval 3½ x 4 ft.; grade of 1 ft. to the mile and dy. cap. of 600,000 galls. After being in use a short time the conduit settled throughout its length and cracks from 50 to 200 ft. long admitted quicksand and water, washing out mortar in arch. At other places large holes in bottom allowed heavy leakage. Conduit was repaired and continued in use.

For high service 1,390 ft. of 24-in. pipe extends from Bleecker reservoir to pump-well.

Inlet Shaft and Tunnel.—Pump-well at Hudson river is 870 ft. from inlet shaft and connected with it by tunnel. In building inlet shaft, brick shaft 10 ft. inside diam. and 47 ft. deep was secured to a c. i. shoe by vertical tie rods, and sunk on pier between river and Erie Canal basin. This shaft cracking, a second, 7½ ft. inside diam., was built within it and sunk 4 ft. further, or to total depth of 51 ft., about

to bed rock, where existing work was made fast by c. i. cylinders, and latter sunk to make total depth for shaft of 80 ft. From this point horizontal drift, 6 ft. in diam., was driven through rock, 220 ft. The part of tunnel from pump-well to Erie Canal basin was already completed, being mostly through hardpan gravel, bricked This was connected with first 220 ft. from river by a drift descending 2½ to 1.

Pumping Machinery.—Dy. cap., 12,000,000 galls. Supply from Hudson river is lifted from pump-well to Bleecker reservoir by pair of comp., cond , beam engines, connected with one fly-wheel. *High service:* pair of comp., cond., beam engines, connected to one fly-wheel, each driving a Thomas-Ditton pump.

Force Mains.—From river station, 9,723 ft. of 30-in. pipe, rising 249 ft. For high service, 410 ft. of 24-in. pipe, rising 55 ft.

Distribution.—*Mains*, c i. (in '87), 90.65 miles. *Services*, lead *Taps*, 14,682. *Meters*, 52. *Hydrants*, Philadelphia, 603; about adopting another kind.

Consumption, unknown. *Pressure*, not given; reservoirs are 144, 246 and 300 ft. above tide-level.

Financial.—Cost, not given. Debt (in '87), $1,089,000. Int., 4, 6 and 7%. Ann. op. exp., not given. Ann. rev.: consumers (in '85), $162,000.

Management.—Five Comrs. Supt., Geo. W. Carpenter.

Reference.—Further data, with section of inlet shaft and tunnel, will be found in Tenth Census U. S., vol. XVII., Water Supply of Cities, pp. 94-6.

ALBION, *Orleans Co.* (Pop., 5,137; est., 5,200.) Has several mills and manufactories.

History.—Built in '88-9 by Albion Water-Works Co. Engrs. and Contrs., Bassett Bros., Buffalo.

Water Supply.—Wells, pumping to stand-pipe: wells from 30 to 100 ft. deep.

Pumping Machinery.—Dy. cap., 1,700,000 galls ; two Volker & Felthousen comp., dup. *Boilers:* two 40-H. P.

Stand-Pipe.—Cap., 250,000 galls.; steel, 75 ft. high, on foundation of Medina sandstone; from Riter & Conley, Pittsburg, Pa.

Distribution.—*Mains*, c. i., 8 miles *Services*, w. i. Pipe and specials from R. D. Wood & Co., Philadelphia, Pa. *Hydrants*, Ludlow, 80. *Valves*, Ludlow.

Consumption, not determined. *Pressure*, 70 to 85 lbs.

Financial.—Cost withheld, est., $120,000. Debt, not given. Ann. op. exp. and rev., not determined. Cap. stock, $100,000. Hydrant rental, $37.50.

Management.—Prest., Geo. M. Wood. Secy., E. M. Bassett, Buffalo. Supt., F. T. Clark.

NOTE.—Above report made in '88.

AMSTERDAM, *Montgomery Co.* (Pop., 9,466; est., 17,000.) On Mohawk river. Manufactures knit goods, carpets and steel springs. Incorp. Has sewers and electric lights.

History.—Built in '82 by city. Engr., Stephen E. Babcock, Little Falls. Surveys for additional supply were made in '89.

Dam and Reservoir.—Cap., 80,800,000 galls.; area, 18 acres. Dam of clay and loam in layers, not rolled, with heart-wall; curved, 410 ft. long, with versed sine of 25 ft.; 65 ft. high, with water 5 ft. below top; 12 ft wide on top; inner slope, 1½ to 1 for 20 ft. from top, where there is a berme 10 ft. wide, then slopes 2 to 1; paved with 12 ins. of stone; outer slope, 2 to 1. *Heart-wall:* main part, rubble masonry, 2½ ft. thick at top, 16 at bottom; puddle wall built 2 ft. from masonry, space between filled with gravel. *Spillway:* excavated in hill, 25 ft. from end of dam; lined with masonry, heavy slope, free. *Discharge-pipes:* two 16-in., in concrete wall; slope, about 2 ins. to 1 ft. Dam does not leak. Built in '81. Engr., see History. Contr., D. S. Reid, Canajoharie.

Conduits.—Water from several streams conveyed to reservoir through salt-glazed, vitrified pipe.

Water Supply.—Surface water, by gravity, from reservoir.

Distribution.—*Mains*, c. i., 19¾ miles, *Services*, lead. *Taps*, 1,586. *Meters*, 54. *Hydrants*, Ludlow, 194 *Valves*, Ludlow. *Pressure-recording gauge*, Edson.

Consumption, about 750,000 galls. *Pressure:* Ordinary, 80 lbs. Fire, 133 lbs.

Financial.—Cost, $332,061. Debt, $282,000: $257,000 at 5, $25,000 at 3% Sinking fund, none. Ann. op. exp., $5,089. Ann. rev.: consumers, $31,867. Hydrant rental, free.

Management.—Prest., Jas. R. Snell. Secy., John McClumpha. Treas., Wm. J. Taylor. Supt., A. H. DeGraff.

Reference.—A further description of these works, especially the conduit, is given in *Eng. News*, vol. XIX., p. 331, a paper read by the Engr., Mr. Babcock, at the Cleveland Convention of the Am. W. W. Assoc., April 17, '88.

ANDES, *Delaware Co.* (Pop., 496; est., 500.) In farming district. Incorp. No sewers or electric lights.

History.—Built in '76 by Andes Water Co.

Water Supply.—Spring, by gravity.

Reservoir.—Cap., 119,000 galls.; 50 ft. sq. x 8 ft. deep; has masonry walls in Portland cement, 3 ft. thick; 6-in. supply, 6-in. waste-pipe, 18 ins. from top. Built in 76. Engr., Thos. S. Miller, Andes. Built by days-work.

Distribution.—*Mains*, c. i., 2 miles. *Services*, lead. *Taps*, 53. *Meters*, none. *Hydrants*, kind not given, 26. *Close of '80*: Mains, 2 miles. Taps, 42. Hydrants, 26.

Consumption, 3,000 galls. *Pressure*, 55 lbs.

Financial.—Cost., $7,200. Cap. stock, $6,000. About 7% dividends are paid. Debt, none. Ann. op. exp., $150. Ann. rev.: consumers, $550; city, none. Cost, '80, $7,200. Rev., $400.

Management.—Prest., Duncan Ballantine. Secy., Treas. and Supt., David Ballantine.

ATTICA, *Wyoming Co.* (Pop., 1,935; est., 3,000.) On Tonawanda River. Incorp. No sewers or electric lights.

History.—Built in 79-80 by Attica Water Co.

Water Supply.—Springs, by gravity.

Reservoir.—Cap., 12,000,000 galls.

Distribution.—*Mains*, c. i., 5½ miles. *Services*, w. i. *Taps* (in '87), 100. *Meters*, 1. *Hydrants*, Mathews, 32. *Valves*, Eddy, mostly.

Consumption, 225,000 galls., about one-half of which is used by Erie R. R. Co. *Pressure*, 62 lbs.

Financial.—Cost, $76,000. Debt, $40,000. Int., 6%. Ann. op. exp., about $500. Ann. rev. (in '87): consumers, $4,500; city, $1,050. Hydrant rental, $35, contract for 5 years.

Management.—Prest., Chas. E. Loomis. Secy., Geo. T. Loomis.

AUBURN, *Cayuga Co.* (Pop. 21,924; est., 26,000.) On high, uneven ground, at outlet of Owasco lake, stream flowing through town and furnishing valuable water power. Has manufactories. Settled in 1793; incorp. city in '48. No sewers. Has electric lights.

History.—Built in '65 by Auburn Water-Works Co., when pop. was about 14,000.

Water Supply.—Owasco lake, by direct pumping. Lake about 1 x 12 miles; drainage area, including lake, 156 sq. m. Supply formerly taken below mouth of outlet of lake, from reservoir formed by dam. See MANUAL for '88, p. 92.

Suction and Syphon Pipe.—Diam., 24 and 30-ins.; length, 9,350 ft. Pipe follows contour of land, and at places is from 10 to 20 ft. above lake. To make vacuum air-pump is attached to a 3-in. pipe, one mile long, connecting at several high points with syphon. An 8,000,000-gall. Gaskill pump is placed at lake end, for use in case syphon fails, which has not occurred in 3½ years.

Pumping Machinery.—Dy. cap., 20,000,000 galls.; 6,000,000 Holly quadruplex, water-power, with Holly engine in reserve, two 700,000 Gaskill horizontal. An 8,000,000 Gaskill is used as stated under suction and syphon pipe, above. For details regarding old pumps, see MANUAL for '88, p. 92.

Distribution.—*Mains*, c. i., 32½ miles. *Services*, w. i. *Taps*, withheld, est., 2,000. *Meters*, 500. *Hydrants*, Mathews, 340.

Consumption, 2,000,000 galls. *Pressure:* Ordinary, 50 lbs. Fire, 80 to 150 lbs.

Financial.—Cost, $500,000. Cap. stock and debt, withheld. Ann. op. exp., withheld, est., $5,000 Ann. rev: consumers, withheld, est., $40,000; city, $17,500. Hydrant rental, $50.

Management.—Prest., A. G. Beardsley. Secy., Treas. and Supt., N. B. Eldred.

AVERNE-BY-THE-SEA, *Queens Co.* See Far Rockaway.

AVOCA, *Steuben Co.* (Pop., est., 1,200.) On Conhocton river. Engaged in manufacturing and trade. Incorp. village. No sewers. Electric lights projected in '89.

History.—Built in '89 by village; put in operation Aug. 1, '89. Engr., E. D. Smalley, Canastota, N. Y. Contr., Charles Brown, Mohawk.

Water Supply.—Springs and creek, by gravity. Springs 140 ft. above, 1½ miles from, village.

Reservoir.—Cap., 1,000,000 galls.

Distribution.—*Mains*, c. i., 5 miles *Services*, w. i. Pipe and specials from Chas. Millar & Sons, Utica. *Taps*, 25. *Meters*, not given. *Hydrants*, Ludlow, 31. *Valves*, Ludlow.

Pressure, 55 lbs.

Financial.—Cost, $19,000. Debt, $18,000. Int., 3½ %.

Management.—Village Trustees. Prest., F. M. Atwood. Secy., A. J. Towner, Date of report, Sept. 10, '89.

AVON, *Livingston Co.* (Pop., 1,617; est., 2,000.) Summer watering place on Genesee river, on terrace 100 ft. above river.

History.—First works were built in '57 by private Co., after plans by McRee Swift. In '85 Co. had 7 mile of pipe, 200 taps and 9 hydrants. Supply from springs by gravity. New system built in '88 by village. Engr., E. D. Smalley, Canastota.

Water Supply.—Conesus lake, 8½ miles distant, by gravity to distributing reservoir.

Intake and Conduit.—Intake extends 1,300 ft. into lake, to 16 ft. of water; w. i., diam. not given. First 1,800 ft. conduit extends along shore to outlet of lake; Wyckoff wood, diam. not given; next 1½ miles vitrified tile, with Portland cement and oakum joints; remaining distance conduit of Wyckoff wood.

Filter.—Midway between lake and reservoir water under pressure passes through coke, confined by w. i.; double, and by reversing the flow, self-cleansing.

Reservoir.—Cap., 500,000 galls.; for fire purposes, only. Bottom, and lower half of slopes lined with 6 ins. of stone; upper half of slopes puddled, then paved. Built in 88. Contrs., Brown & Doyle, Mohawk.

Distribution.—*Mains*, c. i., 12 miles. *Services*, rustless i. C. i. pipe from Charles Millar & Son, Utica; Wyckoff, from Ayrault Bros. & Co., Tonawanda; all laid by Brown & Doyle, Mohawk. *Hydrants*, Galvin, 32. *Valves*, Galvin.

Consumption, not given. *Pressure*, 75 to 110 lbs.

Financial.—Cost, $63,000. Bonded debt, $50,000. Int., 3.7%.

Management.—Prest., G. D. Dover. Sec., Orange Sackett. Treas., P. C. Gleason. No Supt.

NOTE.—Above given in '88, and approximately true for Jan. 1, '89. Later requests for data ignored.

BAINBRIDGE, *Chenango Co.* (Pop., 781; est., 1,000.) On Susquehanna river on undulating ground. Has some manufactories.

History.—Built in '83 by J. M. Roberts.

Water Supply.—Artesian wells, springs and reservoirs, by gravity.

Reservoirs.—Cap., not given; two, one having area of 15 acres, one 50 x 120 ft., x about 16 ft. deep.

Distribution.—*Mains*, w. i., 6 miles. *Services*, w. i., lead. *Taps*, withheld, est., 100. *Meters*, none. *Hydrants*, kind not given, 20.

Consumption, not given. *Pressure*, 115 lbs.

Financial.—Cost, $20,000. Debt., $10,000. Int., 6%. Ann. op. exp., $200. Ann. rev.: consumers, about $2,000; city, $400. Hydrant rental, $500.

Management.—Owner and Supt., J. M. Roberts.

BALDWINSVILLE, *Onondaga Co.* (Pop., 2,121; est., 3,000.) On Seneca river, 12 miles from Syracuse; tobacco center. Has various manufactories.

History.—Built in '89-'90 by village; put in operrtion about Feb. 1. Engr., E. D. Smalley, Canastota. Contrs., Brown Bros, Mohawk.

Water Supply.—Surface well, pumping to stand-pipe. Well is 20 ft. in diam., 20 ft. deep, lined with boiler iron.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two 1,000,000 Gordon dup., comp., cond. *Boilers:* two 80 H. P.

Stand-Pipe.—Cap., 183,000 galls., 25 x 50 ft.; top, 200 ft. above principal business street.

Distribution.—*Mains*, about 8 miles. *Hydrants*, 68.

Financial.—Contract price, $45,055. Bonded debt, $40,000 to $45,000.

Management.—Seven Comrs. Chn., C. N. Bliss. Date of principal report, Nov. 26, '89.

BALLSTON SPA, *Saratoga Co.* (Pop., 3,011; est., 4,500.) Summer resort, 7 miles from Saratoga Springs. Engaged in manufacturing. Incorp. Partially sewered. Has electric lights.

History.—Built in '70 by village, under direction of authorities.

Water Supply.—Springs, by gravity.

Distribution.—*Mains*, w. i. and cem., 12 miles. *Services*, w. i. and cem. *Taps* (in '87), 400. *Meters*, 1. *Hydrants*, Bailey, 107. *Valves*, Eddy.

Consumption, about 600,000 galls. *Pressure*, 36 lbs.

Financial.—Cost, about $100,000. Bonded debt, $76,250. Int., 5 to 7%. Ann. op. exp., about $500. Ann. rev.: consumers, $6,000.

Management.—Village Trustees. Prest., Stephen C. Medbery. Secy., H. C Westcot. Treas., F. H. Beach. Supt., Jas. H. Norris.

BATAVIA, *Genesee Co.* (Pop., 4,845; est., 8,000.) On Tonawanda creek, in slightly undulating country. Engaged in manufacturing agricultural implements, wheels and lumber goods. Settled in '03. Incorp. Has sewers and electric lights.

History.—Built in '65 by village.

Water Supply.—Tonawanda creek, pumping to tank, and direct in case of fire.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Holly Mfg. Co. report 1,500,000 Gaskill dup., do., horizontal.

Tank.—Cap., about 22,000 galls.; wooden, 40 ft. high, on stone foundation.

Distribution.—*Mains*, c. i., 8½ miles. *Services*, galv. i. *Taps*, 100. *Meters*, none. *Hydrants*, Holly, 76.

Consumption, 1,600,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 125 lbs.

Financial.—Cost, $50,000. Debt, $40,000. Int., 3%. Ann. op. exp., $4,000 (probably includes interest on bonds, $1,200). Ann. rev.: consumers, $1,800.

Management.—Water Board. Prest. W. C. Woolsey. Secy., Geo. E. Perrin, Treas., Geo. Roth. Supt., M. W. Hay.

BATH, *Steuben Co.* (Pop., 3,183; est., 5,000.) Has some manufactories.

History.—Built in '87 by Bath Water-Works Co. Engrs. and Contrs., Bassett Bros., Buffalo.

Water Supply.—Wells and springs, pumping to stand-pipe

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Blake.

Stand-Pipe.—Cap., 305,000 galls.; from Farrar & Trefts.

Distribution.—(Dec. 21, '89.) *Mains*, c. i., 8½ miles. *Services*, w. i. Pipe and specials from Buffalo C. I. Pipe Co., Buffalo. *Taps*, 150. *Meters*, 25. *Hydrants*, Ludlow, 73. *Valves*, Ludlow

Consumption, 100,000 galls. *Pressure:* Ordinary, 80 lbs. Fire, 124 lbs.

Financial.—Cost, $100,000. Cap. stock, $72,000. Debt, $60,000. Int., 6%. Ann. rev.: (in '89) consumers, $2,000; city, $2,473. Hydrant rental, $33.80

Management.—Prest., F. A. Hinds. Secy., E. M. Bassett, Buffalo. Treas., S. F. Bagg. Supt., L. B. Cross.

BATH BEACH, *Kings Co.* See Gravesend.

BATH-ON-THE-HUDSON, *Rensselaer Co.* (Pop., 2,046; est., 4,000.) In township of North Greenbush, on Hudson river, opposite Albany. Engaged in handling coal and ice.

History.—Supplied in '88 from works of Greenbush Co. Engr. and Contrs., Moffett, Hodgkins & Clark, Syracuse, who control works.

Distribution.—*Mains*, c. i., 4 miles. *Services*, galv. i. *Taps* 60. *Meters*, none. *Hydrants*, 49.

Consumption, not given. *Pressure:* Ordinary, 80 lbs. Fire, 160 lbs.

Financial.—Ann. rev.: city, $1,300.

Management.—Supt., Jno. Winn.

NOTE. Other data included under Greenbush.

BAYPORT, *Suffolk Co.* See Islip.

BAY RIDGE, *Kings Co.* See Gravesend.

BAY SHORE, *Suffolk Co.* See Islip.

BINGHAMTON, *Broome Co.* (Pop., 17,317; est., 30,000.) On nearly level plain at junction of Chenango and Susquehanna rivers. Has good water-power, many manufactories and large trade. Settled in 1787; incorp. city in '67. Has sewers and electric lights.

History.—Built in '67-8 by city. Const. Engr., Jno. Evans. In '76 rebuilding and enlarging of works was begun, the last w. i. and cem. pipe having been replaced with c. i. in '88. (See Distribution.) Of original works only few hydrants and portion

of pumping station remain. All expenses and improvements, and part of debt, have been paid from earnings and city appropriations, without issuing bonds additional the original $205,000.

Water Supply.—Dug wells and Susquehanna river, direct pumping. Wells are near river.

Pumping Machinery.—Dy. cap., 8,000,000 galls.: a 2,000,000 and 6,000,000 Holly, quadruplex, comp., cond.; 12,000,000 Gaskill horizontal crank was contracted for in '89; 1,000,000 Holly quadruplex was formerly in use.

Distribution.—*Mains*, c. i., 31 miles; the original 21 miles of w. i. and cem. have been replaced with c. i. at a cost of $134,200. *Services*, w. i., lead, galv. i. *Taps*, 3,807. *Meters*, 233. *Hydrants*, Mathews, 291. *Valves*, Eddy. *Pressure-recording gauge*, Edson.

Consumption, 2,891,983 galls. *Pressure:* Ordinary, 50 lbs. Fire, 65 lbs.

Financial.—Cost, $471,000. Debt, $179,000: $25,000 at 7 (due in 1901), $92,000 at 3½ (due in 1907), $62,000 at 3½% (due in 1918). Ann. op. exp., $14,000. Ann. rev.: consumers, $61,583. Cost in '70, $221,000.

Management.—Comrs., Prest., Jno. Anderson. Secy., H. E. Allen. Treas., Jas. B. Weed. Supt., D. Felter.

BROOKLYN, *Kings Co.* (Pop., 566,663; est., 770,000.) Opposite N. Y. City, on west end of Long Island. Elevation of city varies from about tide-level to 60, 80 and 120 ft., in various parts, and is 200 ft. at Prospect Park.

History.—Built in '56-9 by city. In '55 pop. was 205,250, supplied entirely from wells. Des. Engr., Saml. McElroy. Nassau Water Co. was formed to construc. works, and let contract for $4,025,000, but before work was begun city took up stock, appointed five commissioners to supervise work, with Jas. P. Kirkwood, Chf. Engr., and S. McElroy and Moses Lane, Asst. Engrs. Afterwards, management was vested in Nassau Water Board, of three members appointed by Mayor and Aldermen, and in '74 it was transferred to Board of City Works. Since Mr. Kirkwood, Chf. Engrs. have been Moses Lane, Julius W. Adams, and Robert Van Buren; the latter still holds the office.

Water Supply.—Surface water, open wells, and Andrews Bro.'s system of driven wells, by pumping to reservoirs. There are 3 open wells, 50 ft. in diam., and 4 stations with driven wells. Whole supply is drawn from sandy southern slope of Long Island, from drainage area of 74 sq. m.

Original supply was conveyed to pumping station by conduit connecting with several ponds, and forced thence to Ridgewood distributing reservoir. From mains leading from this reservoir water is now pumped to high service reservoir on Mount Prospect. Later, other ponds were brought into service, but as these were below conduit, pumping stations were built at each. Since '83, Wm. D. Andrews & Bro. have put in driven wells, making five additional stations from which water is pumped to conduit.

In '88-9 new gang-well (the fifth) and pond-pumping station was built at Baiseley's pond. A dy. yield of 6,000,000 galls. from wells and 3,000,000 additional from pond was expected.

Latter part of '89 contracts were let for large addition to supply.

Conduit.—All water either passes by gravity, or is pumped, into conduit, and goes to Ridgewood pumping station, where it is lifted to Ridgewood reservoir. Conduit of masonry, underground, with gradient of ⅛ ft. per mile, to pump-well 7 miles from East river. From pump-well to first pond, 4¾ miles, conduit has base 15 ft. wide, on which rest rubble stone masonry walls, surmounted with semicircular brick arch. Bottom and sides are lined with 4 ins. of brick. Bottom is segmental arch of 9.75 ft. chor l and 0.67 ft. versed sine. From 2 ft. above spring of invert, side walls are 10 ft. apart and the arch is 1 ft. thick. Beyond first pond, sectional area of conduit is diminished in proportion to amount of water to be carried. At pump-well conduit is 1.75 ft. above tide-level.

Pump-Well.—Rectangular chamber, with granite walls and bottom, 10 x 60 ft., x 35 ft. high. Foundation 15 ft. below water-level of surrounding country, rests on three courses of 2-in. plank, spiked to sills laid in sand. No settlement has appeared.

Pumping Stations.—*Ridgewood:* combined cap., 60,000,000 galls., with new 20,000,000-pump contracted for latter part of '88. Cap. of each old pump, 15,000,000 galls. No. 1, driven by vertical beam-engine; No. 2, old pumping engine made by Beach & Woodruff, Hartford, Conn.; No. 3, driven by vertical beam and fly-wheel engine, made by Hubbard & Whittaker, Brooklyn; No. 4, Davidson.

Prospect: pumping from mains to high service reservoirs. No. 1, driven by old engine, and used as reserve; No. 2, driven by Wright engine.

Other stations: There are 8 smaller stations, each having two pumps with dy. cap. of from 2,500,000 to 5,000,000 galls. The 8 pumps at driven well stations in '87 were all Knowles; besides these there are 2 Davidson and 2 5,000,000 Worthington.

Ridgewood Reservoir.—Cap., 160,000,000 galls.; water-surface, 25½ acres; depth, 20 ft.; 3,400 ft. from, and 163 ft. above, pump-well; in excavation and embankment, inner slope lined with stone wall 12 to 15 ins. thick, first laid dry, but washing of waves made breaches, and joints were packed with cement mortar. The remedy was effective. In '89 contract was let to double present cap.

Mount Prospect High Service Reservoir.—Cap., 20,000,000 galls.; area, 3.43 acres; about 200 ft. above tide-level.

Hempstead Storage Reservoir.—Built in '73-6. Cap., 1,000,000 galls.

Distribution.—*Mains*, c. i., 407 miles. *Services*, lead. *Taps*, 82,217. *Meters*, Crown, Worthington, Gem, Thompson, 2,137. *Hydrants*, about 3,710; many kinds, including Eddy, Chapman, Ludlow, Galvin. *Valves*, Eddy, Chapman, Coffin, Ludlow. *Pressure-recording gauge*, Edson.

Consumption, 49,801,791 galls. *Pressure*, 40 lbs.

Financial.—Cost, about $13,700,000. Bonded debt, $11,682,500. Int., av., about 5.85%. Sinking fund, $475,000. Ann. op. exp., $625,527. Ann. int., $541,063. Ann rev.: consumers, total, $1,408,488; city, none.

Management.—Comr. City Works, Jno. P. Adams. Chf. Engr., Robert Van Buren. Water Purveyor, Henry Hawkes. Registrar, Edw. J. O'Flynn. Pumping Engr., Edw. Fry.

References.—More detailed information can be found regarding the Hempstead reservoir, over the construction of which there was much litigation, by refering to *Eng. News*, vol. V., p. 257. Other references to the same source are: on general subject of available supply, vol. VII., p. 345; general description, vol. VIII., pp. 114, 121-2; tests of Davidson pumping engines, vol. XII., pp. 220-2. For general description and illustrations, see Tenth Census U. S., vol. XVII., Water Supply of Cities, pp. 83-90.

BUFFALO, *Erie Co.* (Pop., 155,134; est., 250,000.) At foot of Lake Erie and at head of Niagara river. Has extensive manufactories and trade. Incorp. Has sewers and electric lights.

History.—Built in '52 by Co., when pop. was about 50,000, and purchased by city in '68. Engr. original works, Wm. J. McAlpine, deceased; for all additions and improvements since '70, Louis H. Knapp, Buffalo.

Water Supply.—Niagara river, direct pumping and pumping to reservoir.

Intake Tunnel.—Water is drawn from river through tunnel 8 ft. sq., and 1,020 ft. long; limestone rock through which it was blasted being of such nature that it was not necessary to line it. Tunnel extends some distance under stream and connects with inlet of cut stone. Jno. Bat.in was connected with tunnel as Engr. Both of these have been enlarged in '88. Contr., Jno. Hickler.

Pumping Machinery.—Combined cap., 104,000,000 galls. *Low service:* cap., 95,000,000 galls.: one 10,000,000, two 15,000,000 Worthington; one 15,000,000, two 20,000,000 Gaskill. *High service:* cap., 10,000,000 galls.: Holly, 1,500,000; rotary, 2,500,000, and 6,000,000 quadruplex.

Reservoir.—Cap., about 14,000,000 galls.; in embankments, 201 x 533 ft. at top, 158 x 490 ft. at bottom, 21 ft. deep; slopes, 1½ to 1; inner, covered with 1 ft. of puddle and paved with brick. Bank, 13 ft. wide at top. A new reservoir has been projected; cap., 125,000,000 galls.

Distribution.—*Mains*, c. i., 252 miles. *Services*, lead. *Taps*, 32,650. *Meters*, 115. *Hydrants*, Buffalo, 2,285. *Valves*, Eddy, Ludlow. *Close of '71:* Mains, 67½ miles. Taps, 4,227. Meters, none. Hydrants, 497. *Close of '80:* Mains, 102 miles. Taps, 9,137. Meters, 57. Hydrants, 1,118.

Consumption, 42,590,042 galls. *Pressure*, 30 lbs.

Financial.—Cost, $4,826,189. Debt, $3,110,832: $1,474,332 at 7, $100,000 at 6, $250,000 at 5, $404,000 at 4, $882,500 at 3½%. Ann. op. exp., $133,409. Ann. int., '88, $168,185. Ann rev.: consumers, $394,778; city, $100,000, for all purposes. Cost, close of '71, $547,629; '80, $1,526,000. Rev., '71, $124,865; '80, $216,214.

Management.—Three Comrs. Prest., Louis P. Relchert. Secy., Jas. Ryan. Treas., John T. Reese. Engr. and Supt., Louis H. Knapp.

NOTE.—A more detailed description of tunnel and brief account of its construction is given in Drinker's "Tunneling," p. 862, edition of '78, or p. 956, edition of '82.

CAMBRIDGE, *Washington Co.* (Pop., 1,483; est., 1,800.) In townships of Cambridge, Jackson and White Creek. Incorp. No sewers or electric lights.

History.—Built in '86 by Cambridge Water-Works Co., under 20-years franchise. Des. Engr., C. W. Knight, Rome. Const. Engr., W. C. Hawley, Cambridge Contr., Adam Miller, Rome.

Water Supply.—Springs, by direct pumping from collecting reservoir; surplus goes to fire-protection reservoir, which is also fed by springs, and by stream.

Collecting Reservoir.—Cap., 3,000,000 galls.; in embankments, 50 ft. below reservoir.

Pumping Machinery.—Dv. cap., 1,000,000 galls.; from Contr.

Force Main and Supply Mains.—The 6-in. force main, connecting with distributing system, is joined to an 8-in. supply main from fire-protection reservoir, about ⅛ mile from said reservoir. At junction, an automatic valve, normally closed, keeps water from flowing from upper reservoir, until, in case of fire, this pressure from force main is lessened and direction of flow changed.

Fire Protection Reservoir.—Cap., 4,000,000 galls.; 175 ft. above, 2¾ miles from, village.

Distribution.—*Mains*, c. i., 6½ miles. *Services*, galv i. *Taps*, 90. *Meters*, 1. *Hydrants*, Ludlow, 35. *Valves*, Eddy.

Consumption, 40,000 galls. *Pressure*, 80 lbs.

Financial.—Cost, $40,000. Cap. stock, $40,000. Bonded debt, $28,000. Int., 5%. Ann. op. exp., $200. Ann, rev.: consumers, withheld, est., $2,000; city, $1,350. Hydrant rental, $40.

Management.—Prest., Wm. McKee. Secy. and Treas., C. T. Hawley. Supt., John Larmon.

CAMDEN, *Oneida Co.* (Pop., 1,598; est., 2,500.) Manufactures furniture and knit goods. Incorp. No sewers. Has electric lights.

History.—Built in 86 by village. Engr., E. D. Smalley, Canastota. Contrs., Sherman & McDonough, now Troy Public Works Co., Troy.

Water Supply.—Small stream, by gravity. Stream has mean dy. av. flow of 1,500,000 galls.

Dam and Reservoir.—Cap., 2,000,000 galls.; area, 1.64 acres. Dam of gravel, sand and loam, with heart-wall; 275 ft. long, 14 ft. high, water 10 ft. below top; 10 ft. thick on top, 45 ft. at bottom; inner slope, 2 to 1, with 18 ins. of riprap; outer, 1⅛ to 1.

Heart-wall: masonry, 6 ft. thick at bottom, 3 at top, which is 2 ft. below top of dam; extends 1 ft. below bottom of foundation. *Spillway:* in middle of dam. 25 ft. wide lined with masonry, free; slope towards water 10 to 1. *Discharge-pipe:* 14-in., sloping 2 ft. in 100. Dam does not leak badly. Built in '86. Engrs. and Contrs., see History. Cost, $9,000.

Distribution.—*Mains*, c. i., 6½ miles. *Services*, w. i. *Taps*, 212. *Meters*, none. *Hydrants*, Ludlow, 38. *Valves*, Eddy.

Consumption, 200,000 galls. *Pressure*, fire, 75 lbs.

Financial.—Cost, $36,109, not including right of way. Debt, $40,000. Int., 3½%. Ann. op. exp., about $150. Ann. rev.: consumers, $1,500; city, none.

Management.—Water Board. Secy., Fred. S. Gamble. Supt., Wm. Streator.

CANAJOHARIE, *Montgomery Co.* (Pop., 2,013; est., 2,400.) On Mohawk river; incorp. village in '29.

OLD WORKS.

General Description.—Built in '52 by private Co., after plans by J. W. Perkins. Supply was from springs, by gravity, for domestic use, and by pumping to reservoir for fire protection. In '84 this system was reported as having: *Mains*, c. i., 2 miles; *Services*, w. i.; *Taps*, 118; *Meters*, none; *Hydrants*, 11. Works had then cost $22,000, and had debt of $12,000 at 6%. [Probably these works were sold to the Canajoharie Water-Works Co. See below.]

CANAJOHARIE WATER-WORKS CO.

History.—Built in '84. In '89 the works were sold at mortgage sale to Sprakes & Halles.

Water Supply.—Springs in mountain, *at end of 170 ft. tunnel*, by gravity.

Distribution.—(In '87.) *Mains*, c. i., 5,000 ft. *Taps*, number not known. *Hydrants*, none.

Financial.—(In '87.) Cost, $22,000. Debt, $12,000. Int., 6%. Ann. op. exp., $200. Ann. rev.: $800.

Management.—(In '87.) Five Directors. Supt., H. G. Bragden.

NOTE.—Requests for data made in '89 ignored.

CANANDAIGUA, *Ontario Co.* (Pop., 5,726; est., 7,500.) On Canandaigua lake. Settled in 1789. Incorp. village in '15. Has sewers and electric lights.

History.—Built in '84 by private Co. Engrs., Moffett, Hodgkins & Clarke, Syracuse.

Water Supply.—Lake Canandaigua, pumping to tank. Water taken from lake 2,600 ft. from shore.

Pumping Machinery.—Cap., 3,000,000 galls.; two Worthington, with 14 and 20-in. cylinders and 15-in. stroke.

Force Main.—Rises 135 ft.

Tank.—Cap., 380,000 galls.; 40x40 ft.; 135 ft. above village.

Distribution.—*Mains*, c. i., 14 miles. *Services*, galv. i. *Taps*, 425. *Meters*, none. *Hydrants*, Ludlow, 84.

Consumption, 600,600 galls. *Pressure:* Ordinary, 72 lbs. Fire, 150 lbs.

Financial.—Cost, $151,000. Debt, $125,000. Int., 6%. Ann. op. exp., $5,000. Ann. rev.: $12,500; city, $4,000. Hydrant rental, $40.

Management.—Prest., Treas. and Supt., F. B. Merrill. Secy., H. H. Lane.

CANASTOTA, *Madison Co.* (Pop., 1,569; est., 3,000.) Manufactures glass, rakes, knives and knit goods. Has electric lights.

History.—Built in '85 by village. Des. Engr., E. D. Smalley, Canastota. Contrs. Sherman & McDonough, now Troy Public Works Co.

Water Supply.—Springs, by gravity.

Dam and Reservoir.—Cap., 7,000,000 galls.; depth, about 20 ft. Dam of earth, with puddle heart-wall; inner slope, 2 to 1; outer, 1½ to 1.

Distribution.—*Mains*, c. i., 9 miles. *Services*, c. i. *Taps*, 200. *Meters*, none *Hydrants*, kind not given, 54.

Consumption, unknown. *Pressure*, 100 lbs.

Financial.—Cost, $70,000. Bonded debt, $70,000. Int., 4%. Ann. op. exp., $500. Ann. rev.: consumers, $1,500.

Management.—Supt. Decatur Gee.

CANISTEO, *Steuben Co.* (Pop., est., 3,000.) Manufacturing village. Incorp. No sewers or electric lights.

History.—Built in '87-8 by Canisteo Water-Works Co. Engr., Geo. R. Harlow, Pittsburg, Pa. Contr., Jas. H. Harlow & Co., Pittsburg, Pa.

Water Supply.—Springs, 1¾ miles from village, by gravity.

Reservoir.—Cap., 2,000,000 galls.; elevation, 170 ft.

Distribution.—*Mains*, c. i., 6 miles. *Services*, iron, lead. Pipe and specials from Sayre Pipe & Foundry Co., Sayre, Pa. *Taps*, 134. *Meters*, none. *Hydrants*, Mathews, 54. *Valves*, Eddy.

Consumption, unknown. *Pressure*, 70 lbs.

Financial.—Cost, $45,000. Cap. stock, $25,000. Bonded debt, $30,000. Int., 6%. Ann. op. exp. and rev., not determined at time of report. For 50 hydrants $15,000 in cash was paid,

Management.—Prest. and Supt., O. O. Laine. Secy. and Treas., Geo. R. Harlow, Pittsburg, Pa.

CANTON, *St. Lawrence Co.* (Pop., 2,049; est., 4,000.) On De Grasse river. Has manufactories. Incorp. village. Has sewers and electric lights.

History.—Built in '89 by village; completed Nov. 23. Des. Engr., E. C. Cook. Const. Engr., J. Leland Fitzgerald, Schenectady. Contrs., Moffett, Hodgkins & Clarke, Syracuse, with L. J. Richardson in charge.

Water Supply.—De Grasse river, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Deane comp., dup. *Boilers:* 16 x 5 ft., 64 flues; from Porter Mfg. Co., Syracuse.

Stand-Pipe.—Cap., 169,000 galls.; 20 x 72 ft.; gives 130-ft. head for business part of village. Contrs., Sharon (Pa.) Boiler Works.

Distribution.—*Mains*, 10 to 4-in. c. i., 5.6 miles. *Services*, galv. i. Pipe and specials from Jackson & Woodin Mfg. Co., Berwick, Pa. *Taps*, 40. *Hydrants*, Ludlow, 50. *Valves*, Ludlow.

Pressure, 50 to 75 lbs.

Financial.—Cost, about $40,000.

Management.—Comrs. Prest., D. H. Rice. Treas., Ed. Aldrich.

CASTILE, *Wyoming Co.* (Pop. 965; est., 1,200.) Engaged in milling, and manufacturing salt and farm implements; also has large water-cure establishment. No sewers or electric lights.

History.—Built in '88-9 by Castile Water-Works Co.; extended about 2 miles summer and fall of '89 to supply Silver Springs. Const. Engr., F. N. Smith. Contrs., Ayrault & Co., Tonawanda.

Water Supply.—Springs, by gravity.

Reservoir.—Cap., 233,000 galls.; w. i., 60 ft. in diam., 11 ft. deep.

Distribution.—(June 1, '89.) *Mains*, 5.9 miles. *Hydrants*, 25.

Financial.—(June 1, '89.) Cost, $17,000. Hydrant rental, $40.

Management.—Prest., Miles Ayrault, Tonawanda. Secy., M. N. Cole. Treas., G. H. Bush. Date of reports, June 6, '89, Feb. 28, '90.

CATSKILL, *Greene Co.* (Pop., 4,320; est., 6,000.) On Hudson river, at mouth of Catskill creek, on hilly ground. Has manufactories. Incorp. No sewers. Has electric lights.

History.—Built in '84 by village. Engr., W. S. Parker, N. Y. City. Contr., Edw. Shanley, Catskill.

Water Supply.—Hudson river, pumping to reservoir.

Pumping Machinery.—Dy. cap., 3,000,000; two Davidson comp., cond., with 16 and 30-in. steam, and 12-in. water cylinders, all of 24-in. stroke.

Reservoir.—Cap., about 5,000,000 galls.; in excavation and embankment, 250 ft. above river, 154.5 x 269.5 ft. on top, 96 x 195 ft. at bottom, and 23 ft. deep. One side and part of bottom is in rock excavation.

Distribution.—*Mains*, c. i., 12 miles. *Services*, lead. Pipe and specials from Warren Foundry & Machine Co., Phillipsburgh, N. J. *Taps*, 486. *Meters*, 5. *Hydrants*, Mathews, 102. *Valves*, Ludlow.

Consumption, 400,000 galls. *Pressure:* Ordinary, 95 lbs. Fire, 180 lbs.

Financial.—Cost, $150,000. Bonded debt, $150,000. Int., 4%. Ann. op. exp., $5,108. Ann. rev.: consumers, $6,464.

Management.—Five Comrs. Prest., Oliver Bourke. Secy., Calvin H. Jewell. Treas., Wm. S. Van Brocklin. Supt., W. C. Pierson.

CHATEAUGAY, *Franklin Co.* (Pop., 680; est., 1,000.) On Chateaugay river. Has starch, butter, and cheese manufactories. Settled 1796; incorp. village in '68.

History.—Built in '80 by Chateaugay Water-Works Co. Des. Engrs., C. E. Smith and Jno. Hughes, Chateaugay. Const. Engr., E. M. Staunton. Contrs., Goodhue & Birnie, Springfield, Mass.

Water Supply.—Spring, ½ mile from, 125 ft. above village, by gravity.

Distribution.—(In '87.) *Mains*, 6 to 4-in. w. i. and cem., 4 miles. *Services*, galv. i. *Taps*, 100. *Meters*, none. *Hydrants*, Holyoke, 15. *Valves*, Holyoke.

Consumption, not given. *Pressure*, 45 to 60 lbs.

Financial.—(In '87.) Cost, $12,000. Cap. stock, $10,000. No debt. Ann. op. exp., $100. Ann. rev.: consumers, $800; city, $200. Hydrant rental, $13.33.

Management.—Prest. H. D. Farnsworth. Secy., Geo. G. Bently. Supt., Barney Harvey.

NOTE.—Requests for data in '89 ignored.

CHATHAM, *Columbia Co.* (Pop., 1,765; est., 3,000.) In townships of Chatham and Ghent. Manufactures straw paper. Incorp. No sewers or electric lights.

History.—Built in '86 by Chatham Water Co. Engr., Chas. C. Hopkins, Rome. Contrs., R. D. Wood & Co., Philadelphia, Pa.

Water Supply.—Wm. D. Andrews & Bro.'s system of gang-wells, pumping to reservoir.

Pumping Machinery.—Cap., 1,500,000 galls.; Gaskill dup.

Reservoir.—Cap., 1,500,000 galls.

Distribution.—*Mains*, c. i., 5 miles. *Services*, galv. i. *Taps*, 100. *Meters*, none. *Hydrants*, Mathews, 37. *Valves*, kind, do.

Consumption, 300,000 galls. *Pressure:* Ordinary, 80 lbs. Fire, 125 lbs.

Financial.—Cost, $93,000. Cap. stock, $100,000. Debt, $11,300. Int., 6%. Ann. op. exp., $1,600. Ann. rev.: consumers, $1,800; city, $1,[illegible]. Hydrant rental, $50.

Management.—Prest., H. W. McClellan. Treas., P. B. Blum, Sr. Secy and Supt., Philo B. Blum, Jr.

CLINTON, *Oneida Co.* (Pop. 1,236; est., 2,000.) Has manufactories.

History.—Built in '84 by village. Engrs., G. R. & F. K. Baxter, Utica. Contrs., H. J. Reed & Son, Canajoharie.

Water Supply.—Miller brook, by gravity from impounding reservoir, 2½ miles from and 236 ft. above village.

Dam and Reservoir.—Cap., 3,000,000 galls.; area, 1¾ acres; dam of earth, with puddle heart-wall; slopes, 2 to 1, inner slope having wall of field stone laid upon foundation of boulders. *Spillway:* "at s. e. corner of dam," excavated in rock, free. *Discharge-pipe:* 18-in. Just outside dam is small valve-chamber, with valves for regulating the supply or emptying reservoir. There is also valve inside dam on supply pipe; latter has over its end strainer attached to telescopic arrangement of copper tubes, so that it can be raised by means of cable, thus avoiding necessity of a chamber. Does not leak. Built in '84. Engrs., see History. Contrs., built by village.

Distribution.—*Mains*, 16 to 14-in. c. i., 5 miles. *Services*, kind not given. Pipe and specials from Geo. B. Hays. *Taps*, about 80. *Hydrants*, Ludlow, 40. *Valves*, Ludlow.

Consumption, unknown. *Pressure:* Fire, 85 to 100 lbs.

Financial.—Cost, about $36,000. Bonded debt, $35,000; may be paid by village any time between '89 and 1904. Int., 5%. Ann. op. exp., $250. Ann. int., $1,750. Ann. rev.: consumers, $1,091; misc., $325; city, tax of 0.25%, $1,992. Original cost, $35,733.

Management.—Five Comrs. Prest., Chas. H Smyth. Secy., Eugene B. Woolworth. Treas., Wm. Robinson.

Reference.—For a more detailed description, see *Eng. News*, Vol. XIII., p. 135.

CLYDE, *Wayne Co.* (Pop., 2,826; est., 3,500.) In Galen township, on Clyde river. Engaged in manufacturing.

History.—Built in '88-9 by Clyde Water Supply Co. Engrs. and Contrs., Bassett Bros., Buffalo.

Water Supply.—Springs, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 12,000,000 galls; Buffalo dup., cond.

Stand-Pipe.—Cap., 200,000 galls.

Distribution.—(Dec. 31, '89.) *Mains*, 16 to 4-in. c. i., 6 miles. *Services*, not given. *Taps*, 60. *Meters*, 20. *Hydrants*, kind not given, 40.

Consumption, not determined. *Pressure*, not given.

Financial.—Cost, withheld, est., $80,000. Cap. stock (in '88), $50,000. Debt and int., not given. Ann. op. exp. and. rev., not determined. Hydrant rental, $40, 5-years contract.

Management.—Prest., G. B. Bassett. Secy., E. M. Bassett. Both of Buffalo. Treas., C. R. Bassett, N. Y. City. Supt. A. M. Van Buskirk.

COBLESKILL, *Schoharie Co.* (Pop., 1,222; est., 1,600.) Incorp. No sewers or electric lights.

History.—Built in '86-7 by village and operated by Cobleskill Water Co. Engr., W. N. Roberts. Contrs., Stanton & Doyle, Cohoes.

Water Supply.—Springs and surface water, filtered by gravity from impounding reservoir. Drainage area, 2,500 acres.

Dam and Reservoir.—Cap., 120,000,000 galls.; area, 28 acres; greatest depth, 24 ft.; dam of earth with puddle heart-wall; 150 ft. long; inner slopes, 2½ to 1; outer, 2 to 1.

Filter.—At outlet chamber of reservoir; gravel, charcoal and sponge.

Distribution.—*Mains*, c. i., 5 miles. *Services*, lead. Pipe and specials from Warren Foundry & Machine Co., Phillipsburgh, N. J. *Taps*, 82. *Meters*, 3. *Hydrants*, Mathews, 46. *Valves*, Eddy.

Consumption, unknown. *Pressure*, 97 lbs., reduced to 80 lbs. by Ross pressure-valve, made at Troy.

Financial.—Cost, $65,000. Bonded debt, $65,000. Int., 3½%. Ann. op. exp., $300. Ann. rev.: consumers, $2,000; city, none.

Management.—Prest. of Co., M. D. Borst. Secy., Geo. D. Harder. Treas., D. C. Dow. Supt., Jas. N. Borst.

COHOES, *Albany Co.* (Pop., 19,416; est., 21,000.) At junction of Mohawk and Hudson rivers, 3 miles from Troy and 9 miles from Albany, on ground rising from river 230 ft. Has fine water-power and extensive manufactories. Settled in 1725; incorp. village in '48, a city in '70. Has sewers and electric lights.

History.—Built in '48 and '57; in '48 Cohoes Mfg. Co. laid pipes in lower part of village and supplied water from upper level of their canal; in '57 these works were purchased by village for $6,000, and extensions and additions have been made since.

Water Supply.—Mohawk river, pumping to reservoirs.

Pumping Machinery.—Dy. cap., 6,000,000 galls.; three 2,000,000-gall. Lang. *Water-wheels:* two Hercules, of 93 and 165 H. P.

Reservoirs.—Cap., 92,000,000 galls.: 4,000,000, 10,000,000 and 78,000,000 galls., respectively. Last and largest, or high service, reservoir, constructed in '85-6; Contrs., Houlinan & Madigan; area, 14½ acres; in excavation and embankment. Rock and hardpan were met on west side, and face of rock was plastered with cem. beneath foundation of slope-wall to prevent leakage through seams. Inner slopes were faced to top with dry rubble stone walls, 16 ins. thick, and the bottom covered with concrete. Outlet well of reservoir covered with copper wire screen, made in form of dome. 4 ft. in diam. and 18 in. high. Elevation of smallest reservoir, 160 ft.; middle-service, 188 ft.; of high-service, 210 ft. above business part of town.

Force Mains.—Distance from pumps to the first reservoir is about 1,500; to second, 3,900; to third and largest, 6,700 ft. Mains are 10 and 16-in. pipe, part c. i. and part cement-lined.

Distribution.—*Mains*, c. i., w. i., and cem., 26 miles. *Services*, w. i., lead, galv. i. *Taps*, 1,400. *Meters*, 60. *Hydrants*, Ludlow, 200. *Valves*, Ludlow.

Consumption, 4,000,000 galls. *Pressure*, 55 to 90 lbs.

Financial.—Cost, $275,000. Debt, $250,000: $70,000 at 7, $180,000 at 4%. Sinking fund, none. Ann. op. exp., $17,000. Ann. int., $12,603. Ann. rev.: consumers, $32,738; misc., $371.

Management.—Seven Comrs. Prest., Wm. E. Thorn. Secy. and Supt., A. T. Kniffin. Treas., F. B. Golden.

COLLEGE POINT, *Queens Co.* (Pop., 4,182; est., 5,000.) On Long Island, opposite and 10 miles from N. Y. City, on ground gently sloping up from Sound. Has extensive breweries, large hard rubber, and silk manufactories, and is place of residence for N. Y. business men. Settled in '5; incorp. in '65. Has sewers. No electric lights.

History.—Built in '74-5 by village. Des. Engr., J. C. Rossi, with Wm. E. Worthen, New York, Consult. Engr. Const. Engr., A. D. Schlesinger. Contr. for masonry, Robt. Williams; for building, T. L. Tibbs.

Water Supply.—Springs, by direct pumping from impounding reservoir; supply from latter can be augmented, in case of need, by connecting with Fresh Meadow brook, which has drainage area of 9½ sq. m.

Reservoir.—Cap., unknown; area, about 1½ acres; in excavation and embankment, walled. *Discharge-pipe:* 18-in., to pump-well. Built in '74. Engr., see History. Contr., Jno. Higgins. Cost, $12,900.

Pumping Machinery.—Cap., 2,500,000 galls.; two Worthington: one 1,500,000 comp., dup., and one 1,000,000 high-pressure.

Distribution.—*Mains*, c. i., 15 miles. *Services*, lead. *Taps*, 629. *Meters*, Worthington, Gem, Crown, 130. *Hydrants*, Mathews, 60. *Valves*, Eddy.

Consumption, 450,000 galls. *Pressure:* Ordinary, 55 to 60 lbs. Fire, 70 lbs.

Financial.—Cost, $213,000. Bonded debt, $213,000. Int., 7%. Ann. op. exp., $5,000. Ann. rev.: consumers, $15,000; city, none.

Management.—Water Com. Village Prest., Henry Kraemer. Secy., Edw. Buderlinden. Supt., Wm. Taylor.

CONEY ISLAND, *Kings Co.* See Gravesend.

General Description.—First supplied in '80 by works built by Benjamin F. Stephens, Flatbush. In '85, works were sold to Kings County Water Co., Gravesend. In '88 Board of Health found it necessary to erect pumping station and lay water-pipe alongside sewers for flushing at expense of $60,000. Water is taken close to creek and is unfit for use even in boilers at pumping station. It is, however, offered to people along mains, free of charge. There is a 1,000,000-gall. Davidson pump, 6 miles of c. i. mains, furnished by R. D. Wood & Co., Philadelphia, Pa., and laid by Francis P. Gallagher, Coney Island. For flushing sewers 240,000 galls. was pumped daily in '88.

COOPERSTOWN, *Otsego Co.* (Pop., 2,199; est., 3,000.) On narrow valley at south end of Otsego lake and on Susquehanna river; bounded by abrupt hills. Trade center. Incorp. Has sewers and electric lights.

History.—Built in '35 and '79 by Cooperstown Aqueduct Assoc. Supply for the first works was from springs about 50 ft. above village, and was conveyed through bored wooden logs. Later, small water-power pump, placed near lake, lifted water to wooden tank 14 ft. in diam. by 16 ft. deep, from which it was distributed through 2 and 3-in. c. i. pipes.

In '76 Edw. Clark built small gravity works having 150 ft. head. In '79, Co. built new works. Engr., P. H. Baermann, Troy.

Water Supply.—Otsego lake, direct pumping.

Suction Pipe.—Is 10-in. c. i., laid in Susquehanna river and into lake to depth of 38 ft. Up to depth of 10 ft., joints were caulked with 5 wedges and pipe laid from float. At greater depths, ball and socket joint was inserted every 8 or 10 lengths, and intermediate joints caulked with lead; pipe was then lowered from float with block and fall.

Pumping Machinery.—Dy. cap., 1,000,000 galls.: two Worthington crank. *Water-wheels:* 50-in. Leffel turbines, working under 5½ ft. head.

Distribution.—*Mains*, c. i., 5½ miles. *Services*, w. i., lead. *Taps*, 280. *Meters*, none. *Hydrants*, Eddy and "mongrel pattern," 33. *Valves*, Ludlow, Eddy.

Consumption, 250,000 galls. *Pressure:* Ordinary, 75 lbs. Fire, 100 lbs.

Financial.—Cost, $47,000. Debt, $25,000. Int., 6%. Ann. op. exp., $300. Ann. rev.: consumers (in '87), $4,000; city, $660. Hydrant rental, $20.

Management.—Prest., E. M. Harris. Secy. and Treas., J. L. McNamee. Supt., J. Warren Lamb.

CORNELL UNIVERSITY, *Ithaca, Tompkins Co.* (Pop., not given.) On Fall creek, near south end of Cayuga lake. Opened in '68. Has sewers and electric lights.

History.—Built in '75 by University to supply its buildings and its dwellings. Engr., Prof., E. A. Fuertes.

Water Supply.—Fall creek, pumping from impounding to distributing reservoir. Creek has drainage area of 30 sq. m.

Dam.—Just above "Trip Hammer Fall;" masonry, 15 ft. high, abutting on rock at each end; vertical on lower face, battered on upper.

Filter.—When turbid, water is filtered through large wooden box filled with stone, gravel and sand, which is placed in reservoir near gate-chamber.

Pumping Machinery.—Dy. cap., 300,000 galls.; one Worthington, two Cope & Maxwell dup., water-power pumps.

Force Main.—Diam., 4 ins.; rise, 25 ft.

Reservoir.—Cap., 1,000,000 galls.; 145 ft. above University, in excavation and embankment, 100 x 144 ft., x 21 ft. deep; inner slope covered with 2 ft. of clay puddle, on which is laid 10-in. stone facing, grouted with Fayetteville hydraulic lime.

Distribution.—*Mains*, c. i., 2 miles. *Services*, w. i. *Taps*, in '88, 150 or more. *Meters*, none. *Hydrants*, "latest Ithaca make," 14.

Consumption, 80,000 galls. *Pressure*, 35 lbs.

Financial.—Cost, $20,000. No debt. Ann. op. exp., 200. No rev.

Management.—Supt., Prof. J. L. Norris.

CORNING, *Steuben Co.* (Pop., 4,802; est., 7,000.) On Chemung river, ground near river being quite level, but rising 100 ft. to southwest. Has foundries, glass factories and car manufactories. Incorp. Has sewers. No electric lights.

History.—Built in '70 by town, and leased Jan. 1, '78, to Heermans & Lawrence for 30 years, lessees to furnish water for fire protection, free.

Water Supply.—Monkey Run creek and springs, by gravity, direct pumping and pumping to reservoir. First supply was by gravity, but as it was sometimes insufficient, pump was put in and water drawn from springs and ponds.

Reservoir.—Cap., 3,500,000 galls.: area, 0.4 acres; in excavation and gravelly clay embankment; bank 10 ft. wide on top, with water 5 ft. below; on slope of hill, near village, 250 ft. above river. Original cap., 2,000,000 galls.; enlarged in '89. Inner slopes, 2 to 1, old part paved with brick; new with stone. *Heart-wall:* original reservoir without heart-wall, but new part has double row of boards in center, spiked together, extending about half of depth. *Discharge-pipe:* not described. Dam does not leak.

Pumping Machinery.—Dy. cap., 1,000,000 galls.: Martin dup.

Distribution.—*Mains*, c. i., 7 miles. *Services*, galv. i. *Taps*, 620. *Meters*, 74. *Hydrants*, Mathews, 74.

Consumption, 350,000 galls. *Pressure*, 90 lbs.

Financial.—Cost, $75,000. No debt. Ann. rev.: city, none.

Management.—By lessees. Supt., H. C. Heermans.

CORTLAND, *Cortland Co.* (Pop., 4,050; est., 9,000.) On Tioughnioga river Has various manufactories. Incorp. No sewers. Has electric lights.

History.—Built in '84 by Cortland Water-Works Co., controlled by Moffett Hodgkins & Clarke, Syracuse, Contrs.

Water Supply.—Springs, pumping to tank.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two 1,500,000 Worthington; one comp., with 14 and 20-in. steam, and 12-in. water cylinders; a high-pressure, with 18½-in. steam, 14-in. water cylinders, all of 10-in. stroke.

Tank.—Cap., 375,000 galls.; 40 x 40 ft.; 125 ft. above, and ½ mile from main street of village.

Distribution.—*Mains*, c. i., 15 miles. *Services*, galv. i. *Taps*, 645. *Meters*, 43. *Hydrants*, kind not given, 125.

Consumption, 300,000 galls. *Pressure:* Ordinary, 70 lbs. Fire, 150 lbs.

Financial.—Cost, $175,000. Debt, $130,000. Int., 5%. Ann. op. exp., $3,000. Ann. rev.: consumers, $8,400; city, $4,000. Hydrant rental, about $30.

Management.—Prest. and Supt., B. F. Taylor.

CUBA, *Alleghany Co* (Pop., 1,251; est., 1,500.) In agricultural district. Incorp. village. No sewers or electric lights.

History.—Built in '89 by village. Des. Engr., E. D. Smalley, Canastota. No Const Engr. Contrs., King & Keith, Randolph.

Water Supply.—Springs, by gravity.

Reservoir.—Cap., 700,000 galls.; 185 ft. above main portion of town.

Distribution.—*Mains*, 8 to 4-in. c. i., 8 miles. *Services*, galv. i., lead. Pipe and specials from Jackson & Woodin Mfg. Co., Berwick, Pa. *Hydrants*, Ludlow, 38. *Valves*, Ludlow.

Pressure, 80 lbs.

Financial.—Cost, $33,000. Bonded debt [probably] $30,000. Int., 3½%.

Management.—Comrs. Prest., I. N. Sheldon. Report dated Sept. 14, '89.

DANSVILLE, *Livingston Co.* (Pop., 3,625; est., 4,500.) On Mill creek, with hills on three sides. Settled in 1795; incorp. village in '45. No sewers. Has electric lights.

History.—Fire protection system built in '74 by village. Des. Engr., D. M. Greene. **Water Supply.**—Mill creek, by gravity. **Reservoir.**—Cap., 1,000,000 galls. **Supply Mains.**—Bored logs, banded with iron; 10-in., 2 miles long. **Distribution.**—*Mains*, 6 and 4-in. bored logs, 2 miles. *Hydrants*, 54. *Pressure*, 77 lbs. **Financial.**—Cost, $25,000. No debt. Ann. op. exp., $500. **Management.**—Village Corporation. Treas., T. B. Grant.

DAVID'S ISLAND, *Westchester Co.* (Pop., present, 700.) U. S. Army post. Has sewers.

History.—Built in '81-5, by U. S. Government, under supervision of Capt. Geo H. Cook, Asst. Q.-M., U. S. A. Contr., Francis H. Smith, N. Y. City.

Water Supply.—Two artesian wells, pumping to tank.

Pumping Machinery.—Dy. cap., 5,000 galls.; Worthington.

Tank.—Cap., 47,000 galls.; 20 x 20 ft.

Distribution.—*Mains*, 6-in. c. i., 1.7 miles; *Services*, 4-in. c. i. *Taps*, 8. *Meters*, none. *Hydrants*, Mathews, 20. *Valves*, Ludlow.

Consumption, 5,000 galls. *Pressure*, 40 lbs.

Financial.—Original cost, $16,967. Ann. op. exp., not given. No debt or rev.

Management.—Capt. Geo. H. Cook.

DELHI, *Delaware Co.* (Pop., 1,384; est., 1,500.) On west branch of Delaware river. Incorp. village in '21. No sewers or electric lights.

History.—Built in '72 by Delhi Water Co.

Water Supply.—Surface water, by gravity from impounding reservoir on brook about 5 miles long, having high hills on each side.

Dam and Reservoir.—Cap., 500,000 galls.; about ½ mile from and 90 ft. above village. Dam of masonry, 160 ft. long, 14 ft. high. Cost, about $6,000.

Filter.—Gravel, extending back through reservoir from dam; 8 ft. wide at top, 20 at bottom; slopes paved with stone.

Distribution.—*Mains*, c. i., 3½ miles. *Services*, lead. *Taps*, about 200. *Meters*, none. *Hydrants*, Ayers, 33. *Close of '80*: Mains, 3 miles. Taps, 154. Meters, none. Hydrants, 31.

Consumption, not given. *Pressure*, 33 lbs.

Financial.—Cost, $26,000 Debt, none. Ann. op. exp., $250. Ann. rev.: consumers, $2,000; city, none. Hydrant rental, free. Rev. in '80, $950.

Management.—Prest., G. E. Marvin. Treas., D. T. Arbuckle. Supt., J. Middlemist.

DEPOSIT, *Broome Co.* (Pop., 1,419; est., 1,750.) Manufactures carriages, machinery, sash and blinds, and has lumber trade. Incorp. No sewers or electric lights.

History.—Built in '85 by Deposit Water Co., under a 10-years franchise. Engr., Wm. B. Rider.

Water Supply.—Butler brook, by gravity.

Reservoir.—Area, ¼ acre.

Distribution.—*Mains*, c. i., 6 miles. *Services*, w. i., lead. *Taps*, 84. *Meters*, none. *Hydrants*, Cassin, 36. *Valves*, kind, do.

Consumption, 300,000 galls. *Pressure*, 65 lbs.

Financial.—Cost, $30,000. Cap. stock, $25,000. Debt, none. Ann. op. exp., $300. Ann. rev.: consumers, $1,350; city, $600. Hydrant rental, $20.

Management.—Prest., Jno. B. Perry. Secy., Chas. K. Brown. Treas., Jas. S. Minor. Supt., C. M. Putnam.

DOBBS FERRY, *Westchester Co.* (Pop., est., 2,500.) On Hudson river, 6 miles from Yonkers. Has gas burner and piano-stool manufactories. See No. Tarrytown.

DUNKIRK, *Chautauqua Co.* (Pop., 7,248; est , 10,000.) On Lake Erie, on level ground. Commercial center. Settled in '15; incorp. city in '80. Has sewers and electric lights.

History.—Built in '71 by village. Contrs., Holly Manufacturing Co., Lockport. Beginning with Jan. 1, '89, an electric light plant is run in connection with water-works.

Water Supply.—Lake Erie, by direct pumping.

Pumping Machinery.—Dy. cap., 4,500,000 galls.; one 2,000,000 Holly quadruplex and one 2,500,000 Worthington.

Distribution.—*Mains*, c. i., 20 miles. *Services*, galv. i. *Taps*, 955. *Meters*, none. *Hydrants*, Holly, 112. *Valves*, Ludlow.

Consumption, 1,500,000 galls. *Pressure:* Ordinary, 45 lbs. Fire, 105 lbs.

Financial.—Cost, $150,000. Debt, $101,000: $100,000 at 7, $1,000 at 5%. Ann. op. exp., $8,200. Ann. rev.: consumers, $8,560; city, none.

Management.—Five Comrs. Prest., Marshall L. Hinman. Secy., Jno. Madigan. Treas., W. T. Colman. Supt., Geo. M. Abell. Pumping Engr., C. J. Carney.

EAST ALBANY, *Rensselaer Co.* See Greenbush.

ELIZABETHTOWN, *Essex Co.* (Pop., 445; est., 550.) Summer resort in Adirondack mountains, on Boquet river. Incorp. No sewers or electric lights.

History.—Built in '83 by Elizabethtown Water Co.

Water Supply.—Springs, by gravity.

Distribution.—*Mains*, iron, 4 miles. *Services*, galv. i. *Taps*, about 80. *Meters*, none. *Hydrants*, Mathews, 20.

Consumption, not given. *Pressure*, 100 lbs.

Financial.—Cost, about $18,500. Cap. stock, $8,000. Bonded debt, $8,000. Int., 6%. Ann. op. exp., $150. Ann. rev.: consumers (in '87), $1,000; city, $150. Hydrant rental, $7.50.

Management.—Prest , R. L. Hand. Secy., Treas. and Supt., R. C. Kellogg.

ELLENVILLE, *Ulster Co.* (Pop., 2,750; est., 4,000.) In valley at foot of Shawangunk mountains. Manufactures leather, glass, veneering and pocket cutlery. Incorp. No sewers or electric lights.

History.—Built in '71 by city. Des. Engr., Theo. Weston.

Water Supply.—Surface water, by gravity from impounding reservoir ½ mile from and 40 ft. above village.

Dam and Reservoir.—Cap., 1,350,000 galls. 50 x 20 ft., x 18 ft. deep. Dam of earth.

Distribution.—*Mains*, c. i., 8 miles. *Services*, galv. i. *Taps*, 285. *Meters*, none. *Hydrants*, Ayers, 54. *Valves*, Kennedy.

Consumption, unknown. *Pressure:* Ordinary, 35 lbs. Fire, 130 lbs.

Financial.—Cost, $51,000. Debt, $51,000: $35,000 at 7, $16,000 at 3½%. Sinking fund, $22,456. Ann. op. exp., $738. Ann. rev.: consumers, $2,000; city, pays int., and $1,300 for sinking fund.

Management.—Prest., W. H. Deyo. Secy., B. B. Demarest. Supt., D. S. Williams.

ELMIRA, *Chemung Co.* (Pop., 20,541; est., 27,000.) On Chemung river, in narrow valley. Settled in 1787; incorp. city in '64. Has sewers and electric lights.

History.—Built in '60-1 by Elmira Water Co. In '69 Co. was incorp., and now own and operate works under perpetual franchise. Des. Engrs., Alphonse Fteley and Francis Collingwood. Const. Engr., R. M. McDonnell. Labor done by Co.

Water Supply.—Carr's creek, filter galleries, near Chemung river, and Chemung river, by gravity from storage reservoir on creek to distributing reservoir, and by pumping from filters and river to reservoir. Creek has drainage area of 4½ sq. m.

Dam and Storage Reservoir.—Cap., 100,000,000 galls.; area, 26 acres; elevation, 210 ft. above city; dam of earth, with heart-wall; 737 ft. long, 38 ft. high, with top 5 ft. above water; 20 ft. wide on top; inner slope, 2 to 1, riprapped; outer, 1½ to 1, sodded. *Heart-wall:* puddle carried to bed rock, 16 to 23 ft. below natural surface; 20 ft. wide at bottom, 4 at top. *Spillway:* at end of dam, 30 ft. wide; from overfall to stream, of timber and plank. *Discharge-pipes:* 16-in. adjustable supply pipe, passing through natural earth, beneath dam; 20-in. waste-pipe.

Conduit.—W. i. and cem.; 4,500 ft. long; turns up at distributing reservoir, making fountain jet.

Distributing Reservoir.—Cap., 3,750,000 galls.; 300 ft. square and 90 ft. above pumps.

Filter Gallery.—Is in gravel, 100 ft. from Chemung river, 5 ft. wide and 216 ft. long. In '82 its dy. yield was about 1,750,000 galls. It is 90 ft. below distributing reservoir.

Pumping Machinery.—Dy. cap., 9,000,000 galls.; 3,000,000 Knowles erected in '80, and 6,000,000 Worthington high-duty.

Distribution.—*Mains,* 20 to 4-in. c. i., 36 miles. *Services,* lead, galv, l. Pipe and specials from Mellert Pipe Foundry Co., Reading, Pa.; Warren Foundry & Machine Co., Phillipsburgh, N. J.; R. D. Wood & Co., Philadelphia, Pa. *Taps,* 1,667. *Meters,* "Crown and others," 307. *Hydrants,* Mathews, 231. *Valves,* Eddy. No meters prior to '70; 50 hydrants in '70, 137 in '80.

Consumption, 2,250,000 galls. *Pressure,* 44 lbs.

Financial.—Cost, $569,534. Cap. stock, $200,000. Bonded debt, $315,000. Int., 6%. Ann. op. exp., $13,500. Ann. rev.: consumers, $30,000; city, $11,000 for all purposes. Cost in '70, $123,370; in '80, $342,456. Rev. in '70, $18,006; in '80, $30,033.

Management.—Prest., Geo. M. Diven. Secy., Treas. and Supt., J. M. Diven.

FAR ROCKAWAY, *Queens Co.* (Pop., 2,244; est., 3,000.) Summer resort on shore of Long Island.

History.—Built in '84 by private Co., and extended to Rockaway Beach in '87; also supplies Averne-by-the-Sea. Const. Engr. and Contr., Robt. F. Mullins, New York.

Water Supply.—About 50 gang-wells, pumping to stand-pipes.

Pumping Machinery.—Dy. cap., 2,500,000 galls; 1,000,000 and 1,500,000-gall. Davidson. *Boilers:* a Root sectional, and Bigelow return tubular.

Stand-Pipes.—*Far Rockaway:* cap., 235,000 galls.; 20 x 100 ft. *Rockaway Beach:* cap. 59,000 galls.; 10 x 100 ft. Both made by Tippett & Wood, Phillipsburgh, N. J.

Distribution.—(In '87.) *Mains,* c. i., w. i., 12 miles. *Services,* galv. l. Pipe and specials from McNeal Pipe and Foundry Co., Burlington, N. J., Abendroth & Root, N. Y. City, and Builder's Iron Foundry, Providence, R. I. Pipe laid by T. J. Corning and Smith & Vandewater. *Taps,* withheld, est., 300. *Hydrants,* Eddy, Chapman, Holyoke, 80. *Valves,* Eddy, Peet.

Consumption, 600,000 galls. *Pressure:* Ordinary, 43 lbs. Fire, 43 lbs., save at Rockaway Beach, 80 lbs.

Financial.—(In '87.) Cost, withheld, est., $200,000. Cap. stock and debt, withheld. Ann. op. exp., withheld, est., $5,000. Ann. rev.: consumers, withheld, est., $16,000; city, $1,000, half from Far Rockaway and half from Rockaway Beach. Hydrant rental, $50.

Management.—Prest., R. V. W. Du Bois, 120 Broadway, New York. Secy. and Treas., R. F. Mullins, 10 Wall St., New York. Supt., C. A. Lockwood.

NOTE.—Requests for data made in '89 have been ignored.

FISHKILL-ON-THE-HUDSON and MATTEAWAN, *Dutchess Co.* (Pop., two villages, est., 15,000.) On Fishkill creek, one mile from Hudson river. Matteawan has water-power, used in various manufactories. No sewers. Have electric lights.

History.—Built in '86-7 by Fishkill & Matteawan Water Co. Engr., Geo. B. Inman. Contrs., Inman Bros. All of N. Y. city. It was unofficially reported that contract for additional supply from reservoir on No. Beacon Mt. was let in '89 to Henry H. Holmes, Jersey City. Masonry dam would form reservoir.

Water Supply.—Surface water, by gravity from impounding reservoir. See History.

Dam and Reservoir.—Built under separate contract by Mr. Bailey, Co.'s Engr. No other data. See History.

Distribution.—*Mains*, c. i., 10 miles. *Services*, not given. Pipes and specials from Warren Foundry & Machine Co., Phillipsburgh, N. J. *Taps*, 350. *Meters*, 5. *Hydrants*, Mathews, 60. *Valves*, Ludlow.

Consumption, 600,000 galls. *Pressure*, 100 lbs.

Financial.—No data, save hydrant rental, $50. *Estimates:* cost, $150,000. Ann. op. exp., $2,000. Ann. rev.: consumers, $8,000; city, $3,000.

Management.—Prest., G. E. Taintor. Secy., H. M. Gilligan. Treas., G. L. D'Huiller. All of 11 Wall street, N. Y. City Supt., A. S. Brinckerhoff.

FLATBUSH, *Kings Co.* (Pop., 7,631; est., 10,000.) Adjoins Brooklyn, and is on irregular ground.

History.—Built in '82 by Flatbush Water-Works Co. Engr. and Contr., Benj. F. Stephens, Flatbush.

Water Supply.—Wells "Stephens' Patent System," pumping to stand-pipe. There are 12 wells, 8 ft. in diam. and 36 ft. deep, sunk in saturated sand and gravel of southern slope of L. I.

Pumping Machinery.—Dy. cap., 2,500,000 galls.; two Worthington comp., cond., dup.

Stand-Pipe.—Cap., 239,700 galls.; 20 x 102 ft. high. Plate iron, on stone foundation, 6 ft. above ground, which is 84 ft. above pump. Town is on av. 110 ft. below stand-pipe, and is between it and pumping station.

Distribution.—(In '87.) *Mains*, c. i., 30 miles. *Services*, lead. *Taps*, withheld, est., 800. *Meters*, not given. *Hydrants*, kind not given, 142.

Consumption, 750,000 galls. *Pressure*, 75 lbs.

Financial.—(In '87.) Cost, withheld, est., $325,000. Cap. stock, $200,000. Bonded debt, $200. Int., 6%. Ann. rev.: consumers, withheld, est., $25,000; city, $8,000. Hydrant rental, $56.34.

Management.—Prest., Secy. and Treas., not given. Supt., Jeremiah Lott.

NOTE.—Requests for data made in '89 have been ignored.

FLUSHING, *Queens Co.* (Pop., 6,683; est., 8,000.) On Flushing bay, L. I. Manufactures dyes, tools, and has an iron foundry. Incorp. Has sewers. No electric lights.

History.—Built in '74 by village.

Water Supply.—Bored wells, 17, and large pond used only for fire purposes; direct pumping.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; 1,500,000 Holly quadruplex, 1,500,000 Blake.

Distribution.—*Mains*, c. i., 20 miles. *Services*, lead, galv. i. *Taps*, 1,000. *Meters*, 436. *Hydrants*, Mathews, 113.

Consumption, 600,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—Cost, $200,000. Bonded debt, $198,000: $175,000 at 7, $23,000 at 5%. Ann. op. exp., $11,000. Ann. rev.: consumers, est., $13,500; city, '$4,800. Hydrant rental, none.

Management.—Village Trustees, Prest., E. V. W. Rossiter. Supt., G. A. Roullier.

FONDA, *Montgomery Co.* (Pop., 944; est., 1,200.) On Mohawk river. Has flouring and knitting mills and carriage shop. Incorp. No sewers or electric lights.

History.—Built in '85 by village. Engr., Samuel Moak, Amsterdam.

Water Supply.—Springs, by gravity.

Reservoir.—Cap., about 2,000,000 galls. Contrs., Burtch & Snell, Fonda.

Distribution.—*Mains*, iron, 3½ miles. *Services*, lead. Pipe and specials from Warren Foundry & Machine Co., Phillipsburgh, N. J.; pipe laid by Miller & Knight, Saratoga. *Taps*, 104. *Meters*, none. *Hydrants*, Mathews, 31. *Valves*, Eddy.

Consumption, 100,000 galls. *Pressure*, 47 lbs.

Financial.—Cost, $26,000. Debt, $22,000. Int., 5%. Sinking fund, $600. Ann. op. exp., $250. Ann. rev.: consumers, $700.

Management.—Secy., Wm. Maxwell. Supt., S. W. Pulman.

FORT EDWARD *Washington Co.* (Pop., 2,988.) On Hudson river. Has paper and other manufactories. Has electric lights.

History.—Built for domestic supply by Geo. Taylor (deceasee), date not given, and controlled by his widow.

Water Supply.—Springs, by gravity.

Distribution.—*Mains*, w. i. and cem. *Services*, lead.

Financial —Cost, $10,000. No debt.

Management.—Supt., Ransom Qua. No further data can be obtained.

FORT HAMILTON, *Kings Co.* See Gravesend.

FORT PLAIN, *Montgomery Co.* (Pop., 2,443; est., 4,500.) In Meriden township, on Mohawk river. Manufactures axles, springs, stoves, knit and silk goods. Incorp. No sewers Has electric lights.

History.—Built in '85 by Fort Plain Water-Works Co. Engr., A. L. Betts. Contr., J. M. Low, Kingston.

Water Supply.—Springs, by gravity.

Reservoirs.—Cap., 15,000,000 galls.

Distribution —*Mains*, c. i., 13 miles. *Services*, kal. i. Pipe from Warren Foundry & Machine Co., Phillipsburgh, N. J. *Taps*, 150. *Meters*, 1. *Hydrants*, Ludlow, 56.

Consumption, not given. *Pressure:* Ordinary, 79 lbs. Fire, 79 lbs.

Financial.—Cost, about $90,000. Cap. stock, $10,000. Bonded debt, $60,000. Int., 6%. Ann. op. exp., "paid by plumbing department." Ann. rev.: consumers, $2,200; city, $2,240. Hydrant rental, $40.

Management.—Prest., J. M. Low, Kingston. Secy. and Treas., Chas. D. Bruyn. Supt., Chas. Henneberg.

FRANKLIN, *Delaware Co.* (Pep. 660; est., 1,000.) On Ouleont creek, in agricultural section.

General Description.—Construction begun by village latter part '89. Contr., Jehial Vaughn, Stamford. *Mains*, 7,000 ft. *Hydrants*, 17. Prest. Water Comrs., David A. Betts. Secy., Geo. Stilson. Latest report about Aug. 20, '89, just after letting of contracts.

FREDONIA, *Chautauqua Co.* (Pop., 2,692; est., 3,500.) About 3 miles from Lake Erie, on undulating table land. Settled in '05. Incorp. village in '29.

History.—Built in '84 by village. Des. Engr., Emil Kuichling. Const. Engr., Geo. W Rafter.

Water Supply.—Creek, by gravity from impounding reservoir. Drainage area, 24 sq. m.

Dam and Reservoir.—Cap., 8,000,000 galls.; is 3 miles from, and 240 ft. above, village. Dam of stone, 120 ft. long, 25 ft. high, 17 ft. thick at base.

Filter.—A gate-house having 4 filtering chambers was built in dam, although it was not expected that filtering would be necessary.

Distribution.—*Mains*, c. i., 9 miles. *Services*, galv. i., black i. *Taps*, 419. *Meters*, 7. *Hydrants*, Mathews, 56. *Valves*, Ludlow.

Consumption, est., 60,000 galls. *Pressure*, 105 lbs.

Financial.—Cost, $90,000. Debt, $84,000. Int., 4%. Ann. op. exp., $245. Ann. rev.: consumers, $4,000; city, none.

Management.—Comrs. Prest., A. N. Colburn.

FULTON, *Oswego Co.* (Pop., 3,941; est.. 4,500.) On Oswego river. Has water-power, flouring mills, paper mills, box and stove factories and knife works. Has electric lights.

History.—Built in '85 by private Co. Engrs. and Contrs., Moffett, Hodgkins & Clarke, Syracuse.

Water Supply.—Springs, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Worthington.

Stand-Pipe.—Cap., 188,000 galls.; 20 x 80 ft.

Distribution.—*Mains*, 10 to 4-in. c. i., 11 miles. *Services*, galv. i. *Taps* (in '87), 160. *Meters*, Crown, 3. *Hydrants*, kind not given ('87), 32.

Consumption, 200,000 galls. *Pressure:* Ordinary, 55 lbs. Fire, 120 lbs.

Financial.—Cost, $130,090. Debt (in '87), $75,000. Int., 6%. Ann. op. exp., withheld, est., $2,000. Ann. rev.: consumers, withheld, est., $8,000; city (in '87), $1,280. Hydrant rental, $40; 5-years contract.

Management.—Treas., F. A. Emerick.

FULTONVILLE, *Montgomery Co.* (Pop., 881; est., 1,700.) In Glen township, on Mohawk river. Has manufactories. Incorp. No sewers or electric lights.

History.—Built in '75 by J. H. Starin. Engr., Henry Bigerman.

Water Supply.—Springs, by gravity to small reservoir, thence by pumping to large reservoir.

Pumping Machinery.—Dy. cap., 30,000 galls.; Seneca Falls pump.

Reservoir.—Cap., 165,000 galls.; but one described.

Distribution.—*Mains*, 6 and 4-in. w. i., 2 miles. *Services*, not given. *Taps*, 70. *Meters*, none. *Hydrants*, Mathews, 13. *Valves*, Chapman.

Consumption, 20,000 galls. *Pressure:* Ordinary, 65 lbs. Fire, 80 lbs.

Financial.—Cost, $20,000. Cap. stock, $17,000. Debt, not given. Ann. op. exp., $600. Ann. rev.: consumers, $1,800; city, none. Hydrants, free.

Management.—Owner, J. H. Starin.

GARDEN CITY, *Queens Co.* (Pop., 574; est., 1,000.) On Hempstead plains, L. I. Established in '74; maintained by estate of A. T. Stewart.

History.—Built in '76 by A. T. Stewart's estate. Engr., W. R. Hinsdale. Contr., Henry Lewis, Flushing.

Water Supply.—Well, in saturated gravel, direct pumping. Well is 50 ft. in diam., 35 ft. deep, lined with brick wall extending 12 ft. above ground.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Holly quadruplex.

Distribution.—*Mains*, c. i., 11 miles. *Services*, w. i. Pipe and specials from Jesse W. Starr & Son, Camden, N. J. *Taps*, 100. *Meters*, none *Hydrants*, Holly, 35. *Valves*, Holly.

Consumption, 500,000 galls. *Pressure:* Ordinary, 40 to 45 lbs. Fire, 70 lbs.

Financial.—Cost (in '82), $60,000. No debt. Ann. op. exp., withheld, est., $2,000.

Management.—Supt., L. H. Cunliffe.

GENESEO, *Livingston Co.* (Pop., 1,925; est., 2,300.) On Geneseo river, on rising ground; has large machine shops. Incorp. No sewers. Has electric lights.

History.—Built in '87 by village. Des. Engr., J. Nelson Tubbs, Rochester. Const. Engr., Jno. Young, Geneseo. Contrs., Coon & Mooney, Kingston, Pa.

Water Supply.—Conesus lake, pumping to reservoir. Lake is 5 miles from village, ⅜ mile wide, and 9 miles long.

Pumping Machinery.—Dy. cap., 600,000 galls.; Gaskill dup. *Boiler:* 40 H. P. steel tubular.

Reservoir.—Cap., est., 1,000,000 galls.; 150 ft. sq. and 14 ft. deep; 200 ft. above main street.

Distribution.—*Mains*, c. i., 10½ miles. *Services*, w. i. Pipe and specials from Sayre Pipe Foundry, Sayre, Pa. *Taps*, 230. *Meters*, 1. *Hydrants*, Ludlow, 60. *Valves*, Rensselaer.

Consumption, 150,000 galls. *Pressure*, 60 to 160 lbs.

Financial.—Cost, $75,000. Bonded debt, $70,000. Int., 3½%. Ann. op. exp., $2,000. Ann. rev.: consumers, $2,015; misc., $418; city, none.

Management.—Comrs. Prest., W. A. Wadsworth. Secy. and Treas., Theo. F. Olmstead. Supt., Jas. B. Harris.

GENEVA, *Ontario Co.* (Pop., 5,878; est., 7,500.) At foot of Seneca lake, in gently rolling country. Has stove and boiler works, nursery and mercantile business. Settled in 1787; incorp. village in '06. No sewers. Has electric lights.

History.—Built in 1787 by Geneva Water-Works Co. First Engr. and Contr. W. D. Dezeng. Being extended in '87-8: Des. Engr., J. Nelson Tubbs, Rochester; Const. Engr., Geo. A. Hotchkin, Rochester; Contrs., Chambers & Casey, Rochester.

Water Supply.—Until '87, springs, by gravity from reservoirs; in that year pumping was introduced; both systems can be used jointly.

Reservoirs.—Cap., not given. Three; area, about 1 acre.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Worthington. *Boiler:* 100 H. P. tubular.

Distribution.—*Mains*, 12 to 4-in. c. i., 14 miles. *Services*, w. i. Pipe and specials from Jackson & Woodin Mfg. Co., Berwick, Pa.; Gloucester Iron Works, Philadelphia, Pa.; R. D. Wood & Co., Philadelphia, Pa.; Sayre Pipe Foundry, Sayre, Pa.; Buffalo C. I. Pipe Co., Buffalo *Taps*, 350. *Meters*, 24. *Hydrants*, Mathews, 108. *Valves*, Ludlow.

Consumption, unknown. *Pressure:* Ordinary, 45 to 77 lbs. Fire, 75 to 100 lbs.

Financial.—(In '87.) Cost, $126,000. Debt, $100,000. Int., 6%. Ann. op. exp., withheld, est., $1,800. Ann. rev.: consumers, withheld, est., $11,000; city, about $4,700. Hydrant rental, $45.

Management.—Prest., Stephen H. Hammond. Secy., Edw. Kingsland. Treas., Alex. L. Chew. Supt., Saml. S. Graves.

GLENS FALLS, *Warren Co.* (Pop., 4,600; est., 8,000.) On Hudson river Manufactures lumber, lime, collars and shirts. Incorp. village in '39. No sewers. Has electric lights.

History.—Built in '72 by village under direction of trustees. Engrs. and contrs. American Gas and Water Pipe Co., now Ferris & Halladay, Jersey City, N. J.

Water Supply.—Springs, by gravity from impounding and distributing reservoirs.

Dams and Reservoirs.—*Impounding:* cap., 75,000,000 galls.; area, 24 acres: depth, 14 ft.; 5 miles from and 300 ft. above village. Dam of earth and concrete. *Distributing:* cap., about 4,000,000 galls. Dam of stone in cement.

Conduit.—Connects two reservoirs; 5 miles w. i. and cem. pipe; diam., not given.

Distribution.—*Mains*, 12 and 4-in. w. i. and cem., 15 miles. *Services*, w. i., lead. *Taps*, 1,000. *Meters*, none. *Hydrants*, Ludlow, 111. *Valves*, Ludlow.

Consumption, not given. *Pressure*, 90 lbs.

Financial.—Cost (in '87), $130,000. Debt, $100,000; due July, '91. Int., 7%. Ann. op. exp., $1,000. Ann. rev.: consumers, $9,000.

Management.—Trustees. Supt., Geo. H. Thomas.

GLOVERSVILLE, *Fulton Co.* (Pop., 7,133; est., 10,000.) On Cayadutta creek, with high hills in vicinity. Manufactures gloves, mittens, and shoe leather. Settled in '30; incorp. village in '51. Has electric lights.

History.—Built in '78 by village. Chf. Engr., Peter Hogan, Albany. Asst. Engr., C. W. Knight, Rome. Contrs., Sherman, Flagler & Babcock, Troy, now Troy Public Works Co. Contracts were let in '89 to Moore & Shaler, New York City, for extension of works.

Water Supply.—Springs and Rice creek, by gravity from reservoirs.

Dams and Reservoirs.—Combined cap., 16,000,000 galls. First three have cap. of 15,000,000 galls. Two earth dams, masonry heart-walls; one small stone diverting dam. A 1,000,000-gall. reservoir on Rice creek was built in '89.

New Supply Main.—Diam., 18 to 12 ins.; length, 16,450 ft.

Distribution.—(In '87.) *Mains*, c. i., 17 miles. *Services*, w. i., lead. *Taps*, 1,400. *Meters*, 22. *Hydrants*, Mathews, 102.

Consumption, 500,000 galls. *Pressure*, av., 80 lbs.

Financial.—(In '87.) Cost, $120,000. Debt, $97,500. Int., 5 and 6%. Ann. op. exp. in '88, $1,250. Ann. rev.: consumers, $13,000; city, none.

Management.—Comrs. City Clerk, W. E. Learing. Supt., A. A. Hellwig.

NOTE.—Requests for later data under Distribution and Financial ignored.

GOSHEN, *Goshen Co.* (Pop., 2,557; est., 3,000.) In hilly agricultural district. Settled in 1714; incorp. village in '09 and re-incorp. in '43 and '75. Has sewers, built 89. No electric lights.

History.—Built in '71 by village. Engr., Chas. Caldwell, N. Y. City. Contrs., Ferris & Halladay, Jersey City, N. J.

Water Supply.—Springs, by gravity from impounding reservoir.

Dam and Reservoir.—Cap. 46,000,000 galls.; has area of 23 acres, drainage area of 250 acres, and is 1 mile above town. Dam of earth, 260 ft. long, 37 ft. high, 12 ft. wide on top.

Distribution.—*Mains*, w. i. and cem., 5 miles; from Contrs. *Services*, iron. *Taps*, 260. *Meters*, none. *Hydrants*, Ludlow, Chapman, 60.

Consumption, unknown. *Pressure*, 56 lbs.

Financial.—Cost, $75,000. Debt, $32,500: $6,000 at 7, $21,500 at 5, $5,000 at 4%. Ann. op. exp., $4,000 [probably includes, int., $1,685, and possibly extensions]. Ann. rev.: consumers, $2,800.

Management.—Prest. of village, Harrison W. Nanny.

GOUVERNEUR, *St. Lawrence Co.* (Pop., 2,071; est., 3,200.) On Oswegatchie river, which furnishes good water-power. Has marble, talc, iron ore and lumber industries. Founded in '10; incorp. village in '47. No sewers. Has electric lights.

History.—Built in '67 by Gouverneur Water-Works Co.

.—Oswegatchie river, by direct pumping.

Pumping Machinery.—Dy. cap., 450,000 galls.; Green rotary, made by Bagley, Sewal Co., Watertown, and driven by water-power. [A 1,500,000-gall. quadruplex is reported as formerly in use.]

Distribution.—*Mains*, c. i., 4 miles. *Services*, galv. i. *Taps*, 175. *Meters*, none. *Hydrants*, Ludlow, Mathews, 20. *Valves*, kind, do.

Consumption, 275,000 galls. *Pressure*, 40 lbs.

Financial.—Cost, $40,000. Cap. stock, $16,000. No bonds. Debt, $4,500. Int., 6%. Ann. op. exp., $800. Ann. rev.: consumers, $2,500; city, $700. Hydrant rental, $41.

Management.—Prest., W. Boardman. Treas., C. Anthony. Supt., C. A. Van Duzee.

COWANDA, *Erie and Cattaraugus Cos.* (Pop., 1,243; est., 2,000.) On Cattaraugus creek. Manufactures flour, plows, axes and lumber. Incorp. No sewers or electric lights.

History.—Built in '87 by Gowanda Water-Works Co. Engrs. and Contrs., Bassett Bros., Buffalo.

Water Supply.—Springs, by gravity.

Dam and Reservoir.—Cap. 3,000,000 galls.; area, about ½ acre. Formed by dam at junction of two ravines. Dam of clay, 75 ft. long, about 25 ft. high, 16 ft. wide on top, over 100 at bottom. Slopes, unpaved. *Spillway:* in dam at end, lined with masonry, free; slope, about 1 in. to 1 ft. *Discharge-pipe:* 10-in.; slope, about 1 in. to 1 ft. Dam does not leak. Built in '87. Engrs., see History. Work done by Co. Cost, nearly $3,000.

Distribution.—*Mains*, 10 to 4-in. iron, 3 miles. *Services*, iron. Pipes and specials from Mellert Foundry & Machine Co., Reading, Pa., and Jackson & Woodin Mfg. Co., Berwick, Pa. *Taps*, 104. *Meters*, 1. *Hydrants*, Ludlow, 17. *Valves*, Ludlow.

Consumption, 115,000 galls. *Pressure*, 18 lbs.

Financial.—Cost, about $23,000. Cap. stock, $20,000. Debt, none. Ann. op. exp., $100. Taxes, $100. Ann. rev.: withheld, est., consumers, $2,00); city, $600. Hydrant rental, $40.

Management.—Prest., Wm. W. Welch. Secy., F. J. Blackman. Treas., Wm. H. Bord.

CRANVILLE, *Washington Co.* (Pop., 1,071; est., 2,000.) Mettawee river. Has various manufactories. Settled about 100 years ago. Incorp. Partially sewered. No electric lights.

History.—Built in '84 by village. No Engr. or Contr.

Water Supply.—Mettawee river, pumping from storage reservoir direct and to distributing reservoir.

Storage Reservoir.—Cap., not given. Dam, 200 ft. long, 20 ft. high, forms reservoir, and gives power for pumping.

Filter.—*(Not in use.)* Sand, gravel and charcoal in wooden box 10 ft. sq., x 30 ft. long.

Pumping Machinery.—Cap., 316,800 galls.; Knowles, with 14-in. water plunger and 16-in. stroke.

Reservoir.—Cap., est., 400,000 galls.; 50 x 100 ft., x 16 ft. deep; on hill, 50 ft. above village, 100 ft. above pump.

Distribution.—*Mains*, 8 to 4-in. c. i., 4 miles. *Services*, black i. *Taps*, not given. *Meters*, none. *Hydrants*, Chapman, Ludlow, 22. *Valves*, kind, do.

Consumption, 2,000 galls. *Pressure:* Ordinary, 65 lbs. Fire, 100 lbs.

Financial.—Cost, $22,000. Bonded debt, $20,000. Sinking fund, none. Int., 4%. Ann. op. exp., $1,000. Ann. rev.: consumers, $1,000.

Management.—Water Board. Prest., G. W. Henry. Secy., S. B. Norton. Treas. and Supt., O. L. Goodrich.

GRAVESEND, *Kings Co.* (Pop. supplied by these works varies from 10,000 to 100,000.) On southern shore of Long Island.

History.—Kings Co. Water Supply Co. assumed control of Coney Island Water-Works in '85, and extended into township of New Utrecht, supplying in addition to Coney Island, Gravesend, Unionville, Bath Beach, Fort Hamilton, Bay Ridge and Sheepshead Bay.

Original Coney Island Works were built in '80 and consisted of two Knowles pumps, stand-pipe and 6 miles of mains. They were designed, constructed and owned by Benj. F. Stephens, who was also Engr. and Contr. for extensions made by new Co.

Water Supply.—Open wells, "Stephens' Patent System," by direct pumping and pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 6,000,000 galls.; two 1,000,000 Knowles, two 2,000,000 Worthington.

Stand-Pipe.—Cap., 411,000 galls.; 20 x 175 ft.

Distribution.—(In '87.) *Mains*, c. i., 36 miles. *Services*, galv. i., lead. Pipe and specials from Warren Foundry & Machine Co., Phillipsburgh, N. J. *Taps*, 600. *Meters*, not given. *Hydrants*, Chapman, Payne, number not given. *Valves*, kind, do.

Consumption, 2,000,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 80 lbs.

Financial.—(In '87.) Cost, $300,000. Bonded debt, $300,000. Int., 6%. Ann. op. exp., withheld, est., $7,000. Ann. rev.: consumers, withheld, est, $35,000; city, withheld. Hydrant rental, $40.

Management.—(In '88.) Pres., Lorrin Palmer. Treas., Wm. W. Wickes.

NOTE.—Requests for later data ignored.

GREENBUSH, *Rensselaer Co.* (Pop., est., 9,000.) On Hudson river, opposite Albany. Engaged in pork-packing, milling and general manufacturing. Not incorp. Has sewers and electric lights.

History.—Built in '87 by Greenbush Water-Works Co. Greenbush, Bath-on-the-Hudson and East Albany are one municipality, and are all supplied from these works. Engrs. and Contrs., Moffett, Hodgkins & Clarke, Syracuse, who control works. Sub-contr. for masonry and buildings, Henry Brown, Bath-on-the-Hudson.

Water Supply.—Well, 20 x 30 ft., and Hudson river, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 4,000,000 galls.; two Worthington. *Boilers:* No. 5 condenser, and two 80-H. P. return tubular steel.

Stand-Pipe.—Cap., 293,700 galls.; 25 x 80 ft.; from Riter & Conley, Pittsburg, Pa.

Distribution.—*Mains*, c. i., 10 miles. *Services*, galv. i. Pipes and specials from Warren Foundry & Machine Co., Phillipsburgh, N. J. *Taps*, 382. *Meters*, 9. *Hydrants*, Ludlow, 130. *Valves*, Ludlow.

Consumption, 323,466 galls. *Pressure:* Ordinary, 80 to 100 lbs. Fire, 140 lbs.

Financial.—Cost, $200,000. Debt, $155,000. Int., 6%. Ann. op. exp., $3,690. Ann. rev.: consumers, $8,400; city, $4,800. Hydrant rental, about $35.

Management.—Prest., J. F. Moffett. Supt., Jno. Winn.

GREEN ISLAND, *Albany Co.* (Pop., 4,163; est., 5,000.) On Hudson river, opposite Troy. Incorp. Has sewers and electric lights.

FIRST WORKS.

General Description.—In '78 West Troy works were extended here.

GREEN ISLAND WATER CO.'S PLANT.

History.—Built in '88 under 10-years franchise. Engrs. and Contrs., Moffett, Hodgkins & Clarke, Syracuse, who have controlling interest. Water is furnished to West Troy.

Water Supply.—Hudson river, filtered, pumping to stand-pipe and direct.

Filter Gallery.—On Gravel Island, in Hudson river, opposite village. No other data.

Filter Conduit.—To pumps; 20-in. c. i.

Pumping Machinery.—Dy. cap., 4,000,000 galls; two 2,000,000 Worthington comp., dup. *Boilers:* two 5½ x 16 ft.; from Robert Pinkerton, Green Island.

Stand-Pipe.—Cap., about 420,000 galls.

Distribution.—*Mains*, 18 to 4-in. c. i., 3 miles. *Services*, not given. Pipe and specials from Warren Foundry & Machine Co., Phillipsburgh, N. J. *Taps*, 210. *Meters*, 3. *Hydrants*, Ludlow, 53. *Valves*, Ludlow.

Consumption, 1,020,000 galls. *Pressure*, 70 to 100 lbs.

Financial.—Cost, $125,000. Debt, $78,000. Int., 6%. Ann. op. exp., $5,000. Ann. rev.: consumers, $8,000, city, $3,000. Hydrant rental, about $60.

Management.—Prest., J. V. Clark. Supt., C. C. Hill.

GREENPORT, *Suffolk Co.* (Pop., 2,370; est., 2,500.) On Land Island, 95 miles from N. Y. City. Engaged in commerce, agriculture, fishing and manufacturing. Incorp. village. Has electric lights. Has sewers.

History.—Built in '89 by Greenport Water Co., under 10-years franchise; put in operation Aug. 1. Des. Eng., F. W. Miller. Const. Engr., Chas. K. Moore, N. Y. City.

Water Supply.—Four driven wells, pumping to reservoir. Dy. yield of wells in '89, 1,000,000 galls.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Worthington; two, one a comp. *Boiler:* from E. Hodge & Co., E. Boston, Mass.

Stand-Pipe.—Cap., 2 0,000 galls.; from Pete & Wood, Pittsburg, Pa.

Distribution.—(Nov. 27, '89.) *Mains*, c. i., 4 miles. Trenching and pipe-laying done by Chas. K. Moore, N. Y. City. *Taps*, 50. *Hydrants*, 3.

Pressure: Ordinary, 47 lbs. Fire, 90 lbs.

Financial.—(Nov. 27, '89.) Cost, $100,000. Cap. stock, $60,000. Bonded debt, $40,000. Int., 6%. Hydrant rental, $40.

Management.—Prest , C. N. Hoagland. Secy., Chas O. Gates. Treas., E. A. Lovell, 71 Liberty St., N. Y. City. Supt., Geo. Doyle.

GREENWICH, *Washington Co.* (Pop., 1,231; est., 2 000) On Battenkil[1] river. Has manufactories. Incorp. village. No sewers or electric lights.

History.—Built in '87 by Co.; put in operation in Oct. Des. Engr., S. E. Babcock, Little Falls. Const. Engr., Jas. J. Marsh. Labor done by Co.

Water Supply.—Springs, by gravity from reservoir.

Reservoir.—Dy. cap., 8,000,000 galls.

Distribution —*Mains*, c. i., 6 miles. *Services*, galv. i. *Taps*, 114. *Meters*, none. *Hydrants*, Mathews, Ludlow, 27. *Valves*, Eddy.

Consumption, not given. *Pressure*, 90 lbs.

Financial.—Cost, $38,000. Cap. stock, $30,000. Debt, $5,400. No bonds. Int., not given. Ann. op. exp., withheld, est., $800. Ann. rev.: total, $2,800. Hydrant rental, $25; 20-years contract.

Management —Prest., Henry May. Secy. and Supt., Robt. J. Wait. Treas., Leroy Thompson.

GROTON, *Tompkins Co.* (Pop., 913; est., 1,400) On Owasco inlet. Manufactures carriages, cutters and agricultural implements. Incorp. No sewers or electric lights.

History.—Built in '88 by village, and put in operation Dec. 1. Engrs., Reynolds & Morgan, Cuba. Contrs., Moravia (N. Y.) Water-Works Co.

Water Supply.—Springs, by gravity.

Reservoir.—Cap., about 400,000 galls.; 70 x 90 ft., x 14 ft. deep; about ¼ mile from and 210 ft. above, main street.

Distribution.—*Mains*, 10 to 4-in. c. i., 5½ miles; from Chas. Millar & Son, Utica. *Services*, not given. *Taps* (July 1, '89), about 50. *Hydrants*, Bailey, 45. *Valves*, Eddy.

Consumption, not determined. *Pressure*, 90 lbs.

Financial.—Cost, $23,000. Bonded debt, $23,009. Int., 3½%. Ann. op. exp., $150. Ann. rev.: not determined.

Management.—Prest., Ben. Conger. Secy. and Supt., W. D. Baldwin. Treas., Daniel Bradley.

HAMBURGH, *Erie Co* (Pop., 758; est., 1,500.) In agricultural sections Has tannery and flour mills.

History.—Built latter part of '89 by Hamburgh Water and Electric Light Co.

Water Supply.—Surface well, pumping to stand-pipe. Well 50 ft. in diam., 20 ft. deep.

Pumping Machinery.—Dy. cap., 1,250,000 galls.; two Buffalo.

Stand-Pipe.—Cap., not given; 125 ft. high; from Sharon (Pa.) Boiler Works.

Distribution —*Mains*, 5 miles.

Financial.—Cost, est., $35,000. Cap. stock, $12,500. Hydrant rental, $1,000 for all; 20-years contract.

Management.—Prest., T. L. Bunting. Secy. and Treas., H. S. Spencer.

NOTE.—Above subject to correction, as some of the data are unofficial, and official report was made July 23, '89, before construction began.

HANCOCK, *Delaware Co.* (Pop. of township, 3,288.) Incorp. village. No sewers or electric lights.

History.—Built in '89 by Hancock Water Company, under 99-years franchise. Engr., Geo. Cowan, Stamford.

Water Supply.—Springs, by gravity from reservoir.

Reservoir.—Cap., 3,000,000 galls.

Distribution.—(Dec. 1, '89.) *Mains*, 8 to 4-in. c. i., 2¼ miles. *Services*, lead. *Taps*, 25. *Meters*, none. *Hydrants*, Mathews, 20. *Valves*, Eddy.

Pressure, 56 lbs.

Financial.—(Dec. 1, '89.) Cost, $16,500. Cap. stock, $12,000. Bonded debt $8,000. Int., 6%. Ann. op. exp., est., $50; ann. rev.: consumers, est., $250; city, $375. Hydrant rental, $25; 3-years contract.

Management.—Prest., Geo. N. Cowan, Stamford. Secy., Jessie B Cowan Treas., Wm. H. Cowan. Supt., S. N. Wheeler.

HASTINGS-UPON-HUDSON, *Westchester Co.* (Pop., not given.) On Hudson river, 19 miles from N. Y. City. Manufactures car wheels, asphalt brick, cigars, soap, and cuts bluestone. See North Tarrytown.

HAVERSTRAW, *Rockland Co.* (Pop., 3,506; est., 6,000.) On Hudson river. Manufactures brick.

History.—Built in '86-7 by Haverstraw Water Co. Engr. and Contr., Jno. Lockwood, N. Y. City. In '88, West Haverstraw Water Co. was organized to supply West Haverstraw and Grassy Point, and furnish gravity supply to Haverstraw. Works were built in '88, and have since been leased by Haverstraw Water Co. for 99 years. Cost of new works, about $60,000. Engr., W. B. Rider, So. Norwalk, Conn.

Water Supply.—Dorman stream and Minisceongo creek, by gravity from impounding reservoir. Original supply, wells, direct pumping.

Dams and Reservoirs.—*Minisceongo creek:* cap., 600,000,000 galls.; for storage to be drawn upon in summer, and also compensation supply for Garner Print Works, at Garnersville, in consideration of giving up rights in Dorman stream. Dam, 250 ft long, 20 ft. high. *Dorman stream:* cap., 2,000,000 galls.; 3 miles from and 265 ft. above village. Dam, 175 ft. long, 15 ft. high.

Distribution.—*Mains,* c. i., 6 miles. *Services,* galv. 1 Pipe and specials from Warren Foundry & Machine Co., Phillipsburgh, N. J. *Taps,* 140. *Meters,* none: *Hydrants,* partly Holly, '78.

Consumption, not given. *Pressure,* 75 lbs.

Financial.—Cost, $160,000, including both Cos. Cap. stock, $80,000. Bonded debt, $40,000. Int., 6%. Ann. op. exp., withheld, est., $2,000. Ann. rev.: consumers, withheld, est., $10,000; city, $1,100. Hydrant rental, $40.

Management.—Prest., Jno. Lockwood, 52 Broadway, New York. Supt., D. D. Williams.

HERKIMER, *Herkimer Co.* (Pop., 2,359; est., 4,000.) On Mohawk river, in dairying district. Manufactures air-guns, knit goods and paper.

History.—Built in '88 by village. Engr., F. K. Baxter, Utica. Contrs., Beckwith & Quackenbush, Herkimer.

Water Supply.—Driven wells, pumping through distribution to tank; 34 2-in. wells, about 20 ft. deep, nearest being 100 ft. from West Canada creek.

Suction Pipes.—Wells are connected by 2-in. laterals with 3 larger mains ending in sediment-well 3 ft. in diam. by 4 ft. deep, from which 10-in. pipe leads to pump. Contrs., Whitehead & Sluyter, Herkimer.

Pumping Machinery.—Dy. cap., 500,000 galls.; Knowles comp., dup., non-cond. *Boiler:* tubular, about 48 H. P. From Porter Mfg. Co., Syracuse.

Force Main.—Diam., 8 ins.

Tank.—Cap., 530,000 galls.; 60 x 25 ft.; steel; foundation, stone masonry, 61 ft. in diam. Bottom of tank 3/8 ins. thick; sides, first 5 ft., 7-16, next 10 ft., 3/8, top 10 ft., 5-16 ins. thick. Overflow, 6-in. pipe, starts 3 ft. from top, extending down inside. Before placing tank top of foundation covered with 1½ to 2 ins. of dry hydraulic cement, the idea being, according to the Engr.'s report, that when tank was filled, moisture through pores would wet the cement and make it set. Bottom of tank 155 ft. above intersection of Main and German sts. Made by Porter Mfg. Co., Syracuse.

Distribution.—*Mains,* 10 to 4-in. c. i., 7 miles. *Taps,* about 100. *Meters,* not given *Hydrants,* Ludlow, 52. *Valves,* Van Rensselaer.

Consumption, about 80,000 galls. *Pressure:* Ordinary, 77 lbs. Fire, 125 lbs.

Financial.—Cost, $50,000. Debt, about $50,000. Int., 3½%. Ann. op. exp. and rev., not determined.

Management.—(In '88.) Water Board. Prest., W. B. Howell. Secy., Chas. C. Spinner.

HILLBURN, *Rockland Co.* (Pop., 350; est., 500.) On Ramapo river, in hilly country. Founded in '72 by Ramapo Wheel & Foundry Co.

History.—Built by above Co. in '73, for domestic use, after plans by W. W. Snow, their Supt.

Water Supply.—Small stream, by gravity from small reservoir about 60 ft. bove village.

Distribution.—*Mains*, Wyckoff wood, 0.9 miles. *Services*, galv. i. *Taps*, 80. *Consumption*, unknown. *Pressure*, about 20 lbs.

Financial.—Cost, $4,000. No debt. Ann. op. exp., none. Ann. rev.: consumers, $500.

Management.—Supt., W. W. Snow.

HOBART, *Delaware Co.* (Pop., est., 1,000.) On branch of Delaware river. Has manufactories. Incorp. No sewers or electric lights.

History.—Built in '87 by Hobart Water Co., under 99-years franchise. Engr., Geo. N. Cowan, Stamford. Contr., Francis Leonard, Norwalk, Conn.

Water Supply.—Spring brook, by gravity.

Reservoir.—Cap., 380,000 galls.

Distribution.—*Mains*, cem., 2 miles; made by Norwalk (Conn.) Water-Pipe & Construction Co. *Services*, lead. *Taps*, 20. *Meters*, none. *Hydrants*, Holyoke, 10. *Valves*, Ludlow.

Consumption, est., 1,000 galls. *Pressure*, 60 lbs.

Financial.—Cost, $10,225. Debt, $1,900. Int., 6%. Ann. rev.: consumers, $300; city, $120. Hydrant rental, $12.

Management.—Prest., Jas. R. Cowan. Secy., Chas. A. Hanford. Treas., J. S. McNaught. Supt., Arnold S. Carroll.

HOMER, *Cortland Co.* (Pop., 2,331; est., 3,500.) Manufacturing village in agricultural and dairy country. Incorp. Has sewers and electric lights.

History.—Built in '86 by private Co.; controlled by Moffett, Hodgkins & Clarke, Syracuse.

Water Supply.—Springs, pumping to tank.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Worthington.

Stand-Pipe.—Cap., about 150,000 galls.; 25 x 40 ft.; from Sharon (Pa.) Boiler Works.

Distribution.—*Mains*, c. i., 5 miles. *Services*, galv. . *Taps*, 95. *Meters*, 6. *Hydrants*, kind not given, 37.

Consumption, 855,542 galls. *Pressure*, 120 lbs.

Financial.—Cost, $50,000. Debt, $45,000. Int., 6%. Ann. op. exp., $1,100. Ann. rev.: consumers, $2,400; city, $1,650. Hydrant rental, about $45.

Management.—Prest., J. F. Moffett. Supt., L. J. Richardson.

HONEYOYE FALLS, *Monroe Co.* (Pop., 1,098; est., 1,800.) On Honeoye creek, 14 miles south of Rochester. Has several manufactories. Incorp. Partially sewered. No electric lights.

History.—Built for domestic supply in '88 by Honeoye Falls Water-Works and Improvement Co.

Water Supply.—Wells, pumping to tank.

Pumping Machinery.—Cap., 48,000 galls.; from Barr & Creelman, Rochester.

Tank.—Cap., 1,000 galls.

Distribution.—*Mains*, c. i., 4,000 ft. *Services*, w. i. Pipe and specials from Barr & Creelman, Rochester. *Taps*, 54. *Meters*, none.

Financial.—Cost, $3,000. Cap. stock, $2,500. Debt, $200. Int., 6%. Ann. op. exp., withheld, est., $100. Ann. rev.: consumers, $500.

Management.—Prest., W. G. Starr. Secy. and Treas., A. R. Holden. Supt., Robt. Crennel.

HOOSICK FALLS, *Rensselaer Co.* (Pop., 4,530; est., 7,000.) On Hoosick river. Manufactures shirts, malleable iron and agricultural implements. Incorp. Partially sewered. Has electric lights.

History.—Built in '86-7 by Hoosick Falls Water Supply Co. Des. Engr., G. Norman Weaver, Newport, R. I. Contr., Geo. H. Norman, Newport, R. I.

Water Supply.—Wells, pumping to tank.

Pumping Machinery.—Cap., 1,600,000 galls.; Knowles and Russell. 800,000 each. *Boiler:* Cunningham.

Tank.—Cap., 329,000 galls.; 40x35 ft.; from Cunningham Iron Works, Boston, Mass.

Distribution.—*Mains*, w. i. and cem., 8½ miles. *Services*, iron. *Taps*, 300. *Meters*, 3. *Hydrants*, Chapman, Eddy, Holyoke, 84. *Valves*, kind, do.

Consumption, 180,000 galls. *Pressure*, 80 to 120 lbs.

Financial.—Cost, withheld, est., $115,000. Cap. stock, $100,000. Bonds, $100,000. Int. 5%. Ann. op. exp., withheld, est., $2,000. Ann. rev.: consumers, $3,000; city, $3,000. Hydrant rental, $40.

Management.—Prest., John Lockwood. Treas., G. Norman Weaver. Secy. and Supt., E. R. Eastabrook.

HORNELLSVILLE, *Steuben Co.* (Pop., 8,195; est., 13,000.) On Canisteo river; manufacturing town and center of trade. Settled in '20; incorp. village in '52. Has electric lights.

History.—Built in '81 by Hornellsville Water Co. Chf. Engr., W. B. Rider, So. Norwalk, Conn. Asst. Engr., Arthur L. Betts. Contrs., Inman Bros., N. Y. City.

Water Supply.—Mountain streams, by gravity from impounding reservoir.

Dam and Reservoir.—Cap., 50,000,000 galls.; area, 15 acres; 5 miles from and 220 ft. above village. Dam, 450 ft. long, 23 ft. high. No further data.

Filter.—In outlet chamber of dam, gravel and charcoal between wire screens.

Supply Main.—Diam., 16 ins.; length, about 5 miles.

Distribution.—*Mains*, c. i., 20 miles. *Services*, galv. i., lead. *Taps*, (in '87) 800. *Meters* (Crown), 1. *Hydrants*, kind not given, 127. *Valves*, Ludlow. *Pressure-recording gauge*, Edson.

Consumption, unknown. *Pressure*, 95 lbs.

Financial.—(In '87.) Cost, $200,000. Cap. stock, $125,000. Bonded debt, $150,000. Int., 6%. Ann. op. exp., withheld, est., $3,000. Ann. rev.: city, $3,900. Hydrant rental, $30.

Management.—Pres., N. M. Crane. Secy., S. H. Crane. Supt., Geo. L. Tubbs.

NOTE.—Request for later data ignored.

HUDSON, *Columbia Co.* (Pop., 8,670; est., 10,000.) On Hudson river. Slate bluff rises abruptly 60 ft. from river, and from this ground rises gradually for 1½ miles to Prospect hill, 500 ft. above river. Engaged in manufacturing and trade. Settled in 1783; incorp. city in 1785. Has sewers and electric lights.

History.—Early in this century supply of drinking water was introduced through iron pipe from spring 2 miles distant.

In '74-5, pop. being about 8,000, works were built by city. Engrs., J. B. G. Rand and J. H. Emigh.

Water Supply.—Hudson river, pumping to filters, filtered water passing to storage and distributing reservoir.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; from Clapp & Jones Mfg. Co., Hudson.

Filters.—Two; adjoining reservoir on Prospect hill. One with water area of 5,080 sq. ft., area at top of filtering material of 9,071 sq. ft. Another with water area of 30,471 sq. ft., area at top of filtering material of 23,017 sq. ft. Water is admitted to either basin through masonry wells, walls of which are even with top of filtering material, over which water flows. Filtering material in layers: 6 ins. fine white sand; 18 ins. coarse, dark sand; 6 ins. ¼-in. gravel; 6 ins. ½-in. gravel; 6 ins. 1-in. broken stone; 6 ins. 2-in. broken stone; 24 ins. 4 to 8-in. broken stone; total, 72 ins. Bottom of basins is a 6-in. layer of concrete, sloping slightly toward center and outlet. Dry masonry stone culvert leads along bottom of basin to effluent chamber from which water passes to storage reservoir, or can be drawn directly to city. When dirty, top layer of fine sand is removed with flat shovels to depth of 1 in., washed and replaced. The larger filter was constructed in '88. Filter works so satisfactorily that turbid river water becomes clear to depth of 15 ft. in clear water or storage reservoir.

Reservoir.—Cap., 3,200,000 galls.; area, 32,696 sq. ft.; depth, 20 ft.; inner slopes, 1½ to 1, faced with dry rubble masonry, 12 ins. thick at top, 18 at bottom, laid on 9 ins. of 2-in. broken stone.

Supply Mains.—From gate-house near inlet an 18-in pipe leaves reservoir and branches into two 12-in. supply mains.

Distribution.—*Mains*, c. i., 16 miles. *Services*, lead, galv. i. Pipe and specials from Warren Foundry & Machine Co., Phillipsburgh, N. J., and Florence Iron Works. *Taps*, 1,303. *Meters*, 9. *Hydrants*, Ludlow, Mathews, 186. *Gates*, kind. do. *Close of* '80: Mains, 13 miles. Taps, 888. Hydrants, 181. Meters, none.

Consumption, 1,483,389 galls. *Pressure*, 95 lbs.

Financial.—Cost $301,851. Debt, $180,500: $135,000 at 7; $45,500 at 3½%. Sinking fund, none. Ann. op. exp., $11,735. Ann. rev.: consumers, $2,148; city, none. Cost in '80, $257,650.

Management.—Six Comrs. Prest., Wm. H. Traver. Secy., P. Miller. Supt., John S. Roy.

IRVINGTON, *Westchester Co.* (Pop., 1,904: est., 2,500.) On Hudson River, on hilly ground. Summer resort, and engaged in horticulture.

History.—Built in '84 by village. Engr., H. C. Pearson. Contrs., R. D. Wood & Co., Philadelphia, Pa., and Inman Bros., N. Y. City.

Water Supply.—Stream and artesian well, pumping to reservoir. Reservoir first filled from stream, but as this could be depended upon only 6 months in year, artesian well, 8 ins. in diam. and 605 ft. deep, and yielding 26,000 galls. dy., was sunk, and water pumped from it to reservoir.

Reservoir.—Cap., 9,000,000 galls.; 1½ miles from, 412 ft. above, village, formed by enlarging, puddling and paving an old pond; 150x300 ft., x 20 ft. deep.

Pumping Machinery.—Dy. cap. 250,000 galls.; Worthington dup.

Distribution.—(In '87.) *Mains*, c. i., 5 miles. *Services*, lead. *Taps*, 100. *Meters*, 100. *Hydrants*, Mathews, 25.

Consumption, 15,000 galls. *Pressure*, 140 to 186 lbs.

Financial.—(In '87.) Cost, $45,000. Bonded debt, $40,000. Int., 4%. Ann. op. exp., $2,500. Ann. rev.: consumers, $5,000; city, $1,000.

Management.—Supt. (in '88), W. H. Winne.

NOTE.—Inquiries sent in '89 have been ignored.

ISLIP, *Suffolk Co.* (Pop., town, est., 6,453.) On Great South Bay, Long Island. Made up of villages of Bayport, Bay Shore, Islip, Oakdale and Sayville. Summer resort. Incorp. town. No sewers. Has electric lights.

History.—Built in '89-90 by Great South Bay Water Co., to supply Islip, and villages mentioned above. Des. Engr., Jno. Lockwood, N. Y. City. Const. Engr., Jno. C. Lockwood.

Water Supply.—Six-in. wells, pumping to stand-pipe.

Pumping Machinery.—Dy. cap. 1,500,000 galls.; Knowles comp., cond. *Boilers:* from E. Hodge & Co., E. Boston, Mass.

Stand-Pipe.—Cap., 352,000 galls.; 20x150 ft.; from E. Hodge & Co., E. Boston, Mass.

Distribution.—*Mains*, c. i., 25 miles. *Services*, galv. i. Pipe and specials from M. J. Drummond, N. Y. City, and Warren Foundry & Machine Co., Phillipsburgh, N. J.; trenching and pipe-laying done by Jno. C. Lockwood. *Hydrants*, Chapman, 200. *Valves*, Kennedy.

Pressure: Ordinary, 65 lbs. Fire, 100 lbs.

Financial.—Cost, $300,000. Cap. stock, $100,000. Bonded debt, $200,000. Int., 6%. Hydrant rental, $30; 2[illegible] years contract.

Management.—Prest., Jno. Lockwood, 52 Broadway, N. Y. City. Secy. and Treas., Jno. C. Lockwood. Latest report, March 19 '90.

ITHACA, *Tompkins Co.* (Pop., 9,105; est., 12,000.) At head of Cayuga lake, surrounded on three sides by, and partly upon, hills; remainder of village on level land. Engaged in manufacturing. Settled in 1789; incorp. village in '21, city in '88. Has electric lights.

History.—Built in '72 by Ithaca Water-Works Co. Engr., Isaac S. Cassin, Philadelphia, Pa.

Water Supply.—Buttermilk Falls creek, by gravity from impounding and distributing reservoirs. Drainage area, 10 sq. m.

Dams and Impounding Reservoirs.—Two; combined cap., 11,500,000 galls. *First:* cap., 10,000,000 galls.; 3 miles from and 500 ft. above village. *Second:* cap., 1,500,000 galls.; below first, 1 mile from, 212 ft. above, village. Supplies high service. *Dams:* cribs of white pine timber, filled with small stone, then grouted with cement.

Conduit.—Connects lower impounding with distributing reservoir; 2 miles 8-in. c. i.

Distributing Reservoir.—Cap., 1,350,000 galls. At and 146 ft. above village, on side hill, with rock foundation; inner walls of stone masonry in cement, lined with brick; backed on outside with earth, supported by stone retaining wall. Bottom is covered with from 18 to 24 ins. of concrete.

Distribution.—*Mains*, c. i., 18 miles. *Services*, w. i., galv. i. *Taps*, 475. *Meters*, 8. *Hydrants*, 70; made by Treman, Waterman & Co., Ithaca. *Valves*, kind, do.

Consumption, 200,000 galls. *Pressure:* Ordinary, 65 lbs. Fire, 90 lbs.

Financial.—Cost, $224,000. Cap. stock, $100,000. Bonded debt, $75,000. Int., 6%. Ann. op. exp., withheld, est., $2,500. Ann. rev.: consumers, withheld, est., $15,000; city, about $4,000. Hydrant rental, $60.

Management.—Prest., Leonard Treman. Treas., L. L. Treman. Secy. and Supt., E. M. Treman.

JAMAICA, *Queens Co.* (Pop., 3,922; est., 5,500.) On Long Island, 10 miles from Brooklyn; engaged largely in market gardening. Incorp. No sewers. Has electric lights.

JAMAICA WATER SUPPLY CO.

History.—Built in '87. Engr., Jno. Lockwood, N. Y. City.

Water Supply.—Six 6-in. wells, 40 ft. deep, by pumping to tank.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two 1,000,000 Gaskill dup. *Boilers*, Holly.

Tank.—Cap., 795,000 galls.; 50x40 ft.; from Christopher Cunningham, Greenpoint.

Distribution.—*Mains*, c. i., 8 miles. *Services*, galv. i. Pipe from Warren Foundry & Machine Co., Phillipsburgh, N. J., and specials from Builders' Iron Foundry, Providence, R. I. *Taps*, 150. *Meters*, 3. *Hydrants*, Holly, 120. *Valves*, Holly.

Consumption, about 500,000 galls. *Pressure*, 56 lbs.

Financial.—Cost, $165,000. Cap. stock, $75,000 Bonded debt, $90,000. Int., 6%. Ann. op. exp., withheld, est., $2,000 Ann. rev.: consumers, $5,000; city, $2,500.

Management.—Prest., Secy. and Treas., Jno. Lockwood, N. Y. City. Supt., J. Tayler Watts.

JAMAICA TOWNSHIP WATER CO.

General Description.—Built in '88-9, put in operation Aug. Des. Eng., Jno. Lockwood, N. Y. City. Const. Engineer, Jno. C. Lockwood. Water taken from Jamaica Water Supply Co. to supply Morris Park, Richmond Hill and Long Island R. R. shops. *Mains*, 5 miles; from Warren Foundry & Machine Co., Phillipsburgh, N. J. Special from Builders' Iron Foundry, Providence, R. I. *Hydrants*, Holly. *Valves*, Kennedy. Prest., Jno. Lockwood, 52 Broadway, N. Y. City. Secy., Treas. and Supt., Jno. C. Lockwood.

JAMESTOWN, *Chautauqua Co.* (Pop., 9,357; est., 16,000.) At outlet of Chautauqua lake, on hills rising from stream about 200 ft. Engaged in manufacturing. Settled in '10; incorp. village in '27. Has electric lights.

History.—Built in '82 by Jamestown Water Supply Co.; owned since '89 by American Water-Works & Guarantee Co., Pittsburg, Pa.; Engrs. and Contrs., for original works, Holly Manufacturing Co., Lockport; Contrs. for improvements, Denison & Cowell, Muscatine, Ia.

Water Supply.—Artesian wells, by direct pumping Four wells, 8 ins. in diam. and yielding 2,000,000 galls. dy., were driven in '87 or '88, and new pumping station built, 4 miles from first station.

Pumping Machinery.—Dy. cap., 8,400,000 galls.; 3,000,000 Holly quadruplex, 1,750,000 Worthington, 3,650,000 Buffalo.

Distribution.—(In '87.) *Mains*, c. i, 17 miles. *Services*, w. i. *Taps*, 900. *Meters*, 10. *Hydrants*, Holly, 106.

Consumption, 750,000 galls. *Pressure:* Ordinary, 80 lbs. Fire, 120 lbs.

Financial.—(In '87.) Cost, $300,000. Bonded debt, $100,000. Int., 6%. Ann. op. exp., $6,000. Ann. rev.: consumers, $12,000; city, $6,300. Hydrant rental, $60 for first 100, $50 for additional.

Management.—See History. Supt., W. A. Kent.

JOHNSTOWN, *Fulton Co.* (Pop., 5,013; est., 8,000.) On Cayadutta creek. Manufactures gloves, mittens and shoe leather. Incorp. village. Has sewers and electric lights.

History.—Built in '78 by village. Engr., P. H. Baermann, Troy. New supply portion of plant remodeled in '85; Engr., S. E. Babcock, Little Falls.

Water Supply.—Springs and streams, by gravity from impounding and distributing reservoirs.

Dams and Impounding Reservoirs.—Combined cap., not given. *Cold Brook:* cap., not given; area, ⅛ acre; depth, 12 ft. Dam of timber; no further data. *Warren Brook:* cap., not given; formed by dam 5 ft. high.

Conduits.—Cold brook reservoir connected with distributing reservoir by 2,700 ft. 8-in. pipe, falling 33 ft., and 700 ft. 6-in., falling 130 ft Warren brook reservoir also connected by 515 ft. 12-in. c. i. pipe.

Dam and Distributing Reservoir.—Cap., 10,000,000 galls.; area, 2½ acres; 186 to 282 ft. above town. Dam, across ravine, earth with puddle heart-wall; 250 ft. long, 25 ft. high.

Supply Main.—Diam., 10 ins.; length, 19,377 ft.

Distribution.—*Mains*, 12 to 4-in. c. i., (in '87) 12 miles. *Services*, w. i. *Taps*, 944. *Meters*, 32. *Hydrants*, Mathews, 74. *Valves*, Eddy.

Consumption, 500,000 galls. *Pressure*, 100 lbs.

Financial.—Cost, $124.121 Bonded debt, $60,500. Int., 6%. Ann. op. exp., $1,890. Ann rev., consumers, $9,661.

Management.—Four Comrs. Prest., John M. Douglas. Secy., A. J. Wilde. Treas., C. M Rowell. Supt., J. J. Buchanan.

JORDAN, *Onondaga Co.* (Pop., 1,314; est., 2,000.) Engaged in manufacturing. Incorp. Partially sewered. Has electric lights.

History.—Built by M. C. Rodger; date not given. Franchise for new works has been granted to a Co.

Water Supply.—Outlet of Skaneateles lake, pumping to reservoir.

Pumping Machinery.—Dy. cap., 500,000 galls.; water-power, kind not given.

Reservoir.—Cap., 30,000 galls.

Distribution.—*Mains*, w. i., ¾ mile. *Services*, w. i. *Taps*, 20. *Meters*, none. *Hydrants*, kind not given. 12.

Consumption, 10,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, $100.

Financial.—Cost unknown, est., $5,000 Debt, none. Ann. op. exp., $50. Ann. rev.: consumers, $150; city none.

Management.—Owner, M. C. Rodger. Supt., S. L. Rockwell.

KEESEVILLE, *Essex and Clinton Cos.* (Pop., 2,181; est., 2,500.) On both sides Ausable river. Has some manufactories. Settled in 1794; incorp. village in '78. No sewers or electric lights.

History.—Built in '83 by village. Engr., W. H. Lang, Burlington, Vt.

Water Supply.—Ausable river, by direct pumping.

Pumping Machinery.—Dy. cap , 2,000,000 galls. A Flanders and Lang pump.

Distribution.—*Mains*, c. i., 5½ miles. *Services*, w. i. *Taps*, 200. *Meters*, none. *Hydrants*, Ludlow, 49. *Valves*, Ludlow.

Consumption, unknown. *Pressure:* Ordinary, 68 lbs. Fire, 150 lbs.

Financial.—Cost, $38,000. Debt, $26,000. Int., 5%. Ann op. exp., $500. Ann. rev.: consumers, $1,736; city, $2,325.

Management.—Comrs. Prest., W. Harper. Secy. and Treas., H. M. Mould.

KINGS COUNTY FARM AND INSANE ASYLUM, *St. Johnsland, Suffolk Co.* (Pop., 300.)

History.—Built in '88 by Kings County. Chf. Engr., J. F. Casey, N. Y. City. Res. Engr., A. T. Byrne. Contr., Ed. Freel, Brooklyn.

Water Supply.—Two wells, 8 ft. in diam., and surface water from drainage area of 1,000 acres, by direct pumping and pumping to reservoir.

Reservoirs.—Cap. not given. *Storage:* area, 5 acres; depth, 7 ft. *Distributing:* area, 1 acre; depth, 18 ft.; in form of ellipse.

Pumping Machinery.—Dy. cap., 1,400,000 galls.; Worthington dup.

Distribution.—*Mains*, c. i., 4 miles. *Services*, c. i. *Taps*, 30, at time of report. *Meters*, none. *Hydrants*, Mathews, 40. *Valves*, kind, do.

Consumption, not determined. *Pressure:* Ordinary, 80 lbs. Fire, 160 lbs.

Financial.—Cost, $72,400. No further data.

Management.—Supt. Asylum.

NOTE.—Above data for '88.

KINGSTON, *Ulster Co.* (Pop., 18,344; est., 23,000.) On Hudson river, at mouth of Rondout creek, and comprises post offices of Kingston, Rondout and Wilbur. Engaged in manufacturing, and has large river trade. Settled in 1666; incorp. city in 72. Has electric lights.

History.—Built in '83 by Kingston Water Co. Engr., Arthur L. Betts. Contr., J. M. Low, Kingston.

Water Supply.—Sawkill creek, by gravity from impounding reservoir. Creek has drainage area of 25 sq. m. above reservoir.

Dam and Reservoir.—Cap., 60,000,000 galls.; area, 19¾ acres; 7 miles from city, 350 ft. above mean tide-water, giving head of 170 ft. at Kingston and 340 ft. on strand at Rondout. Dam of earth, with masonry heart-wall; 195 ft. long, 35 ft. high; founded on solid rock.

Filter.—Charcoal and gravel.

Supply Main.—Diam., 18 ins.; length, 37,500 ft.

Distribution.- (In '87.) *Mains*, c. i., 33½ miles. *Services*, w. i., lead. *Families supplied*, 1,760. *Meters*, 35. *Hydrants*, Coffin, 255. *Valves*, Coffin.

Consumption, 2,000,000 galls. *Pressure*, 103 lbs.

Financial.—(In 87.) Cost, $600,000. Cap. stock, $300,000. Bonded debt, $300,000. Int., 6%. Ann. op. exp., $4,580. Ann. rev.: consumers, $17,600; city, $10,000. Hydrant rental, $40.

Management.—Prest., Jas. L. Lindsley. Secy. and Treas., C. D. Bruyn. Supt., Alfred Hudler.

NOTE.—Inquiries sent in '89 ignored.

LANSINGBURGH, *Rensselaer Co.* (Pop., 7,432; est., 9,000.) Suburb and branch post-office of, and 1 mile from, Troy. Manufactures collars, cuffs, shirts, brushes, oilcloth and carriages. Settled in 1771; incorp. village in 1790.

History.—Built in '84 by village. Des. Engr., P. H. Baermann, Troy. Const. Engr., W. M. S. Franklyn. Contrs., Sherman & McDonough, Troy, now Troy Public Works Co.

Water Supply.—Oil Mill creek, by gravity from impounding and distributing reservoirs. Drainage area, 3 sq. m.

Dams and Reservoirs.—Combined cap., upwards of 95,000,000 galls. *Impounding No.* 1: cap., 80,000,000 galls.; area, about 33 acres; elevation, about 265 ft. above village. Dam of clay, with heart-wall; length not given; 50 ft. high on outside, 40 ft. water; inner slope, 3 to 1; outer, 2 to 1; top, 20 ft. wide, 5 ft. above water. *Heart-wall:* puddle, carried up about 20 ft. from bottom.

Impounding No. 2: cap. not given; about 20 ft. of water. Dam about same as that of distributing reservoir, described below. Built in '89.

Distributing: cap., 15,000,000 galls.; elevation, 194 ft. above village. Dam of clay and sand, with heart-wall; 27 ft. high, 25 ft. water; length not given; inner slope, 3 to 1; outer, 2 to 1; top 20 ft. wide, 5 ft. above water. *Heart-wall:* puddle, extending about 18 ft. below foundation.

Distribution—(In '87.) *Mains*, c. i., 14 miles from Gloucester Iron Works, Philadelphia, Pa. *Services*, lead. *Taps*, 627. *Meters*, 2. *Hydrants*, Ludlow, 129. *Valves*, Ludlow.

Consumption, not given. *Pressure*, 71 lbs.

Financial.—(In '87.) Cost, $160,000. Debt, $160,000. Int., 4%. Ann. op. exp., $8,000. Ann. rev.: consumers, $7,112.

Management—(In '87.) Five Comrs. Prest., E. Tracy. Secy., H. S. Holmes. Supt. J. Brooks.

LARCHMONT, *Westchester Co.* (Pop., est., 1,000.) Not incorp. Has sewers. No electric lights.

History.—Built in '89-90 by Larchmont Water Co.; to be in operation June 1. Des. Engr., W. H. Disbrow, Mamaroneck. Const. Engr., W. H. Campbell, Larchmont. Labor done by Co.

Water Supply.—Shelldrake lake, by gravity.

Distribution.—*Mains*, 2 miles; from McNeal Pipe & Foundry Co., Burlington, N. J. *Hydrants*, Chapman. *Valves*, Chapman.

Pressure, 38 lbs.

Financial.—No data.

Management.—Prest., George R. White. Secy., C. E. Keene, New Rochelle. Treas., Wm. Murray, 406 Produce Exchange, N. Y. City. Supt., W. H. Campbell. Date of report, Jan. 22, '90.

LE ROY, *Genesee Co.* (Pop., est., 2,800.) In rolling country on Oatka creek, which furnishes good water-power. Manufactures salt, malt, paper, patent medicines and carriages. Settled in 1795. Incorp. Partially sewered. No electric lights.

History.—Built for fire protection in '75 by village. Engrs., La France Steam Fire Engine Co., Elmira. Contrs., Wm. Sherman and Drulard & Hayes. **Water Supply.**—Oatka creek, by direct pumping. **Pumping Machinery.**—Cap., not given; La France pumps, driven by power from Prentice's Flouring Mill. **Distribution.**—*Mains*, c. i., 6½ miles. *Hydrants*, 20. *Pressure*, 110 to 140 lbs. **Financial.**—Cost, $10,000. Ann. op. exp., $1,000. **Management.**—By village. Prest., Thomas B. Tuttle. Supt., S. P. Bacon.

NOTE.—Gravity plant projected for domestic supply.

LITTLE FALLS, *Herkimer Co.* (Pop., 6,910; est., 10,000.) On Mohawk river, which furnishes water-power used for manufacturing purposes. Incorp. Has sewers and electric lights.

History.—Begun in '85, and finished in '88, by village. Engr., Stephen E. Babcock, Little Falls.

Water Supply.—Beaver creek, filtered, by gravity from impounding and distributing reservoirs. Dy. flow, 4,000,000 galls.

Beaver Creek Diverting Dam.—At head of conduit, flooding ¾ acres; elevation, 1,185 ft. above H. R. R. R. tracks in village. Masonry, 6 ft. high, carried to rock foundation, in some cases 9 ft. below natural surface. Gives static head on conduit, at dam, of about 2 ft. *Spillway:* in body of dam, 50 ft. wide. *Gate-chamber:* in south abutment, fitted with screens and inlet weir. *Discharge-pipes:* three; a 14-in. waste-pipe chamber, connected with reservoir; a 6-in. drain-pipe to empty chamber; a 30-in. waste pipe through center of dam to empty reservoir and carry water of stream, if desired. Contrs., Sherman & McDonough, Troy, now Troy Public Works Co. Cost, see Conduit.

Conduit.—Connecting reservoirs; 9¼ miles long, including aerating canal; salt-glazed vitrified stone-ware pipe, with c. i. pipe substituted at crossing of two valleys. From impounding reservoir water is taken from chamber for first 50 ft. through 20-in. c. i. pipe, then for 10,000 ft. through 20-in. stone-ware pipe, with grade of 8 ft. to mile. At this point conduit passes through 30-ft. sand cut about 1,000 ft., after which it is reduced to 18 ins. for 9,400 ft., at grade of 13 ft. to mile. Valley of Gillett creek crossed by 6,200 ft. 18-in. c. i. pipe. Next 9,100 ft. 18-in. vitrified pipe on hydraulic grade to Crum creek valley, which is crossed by 9,400 ft. 16-in. c. i. pipe, at grade of 32 ft. to mile. Next comes 900 ft. 15-in. vitrified pipe, grade 79 ft. to mile, then 1,009 ft. 12-in vitrified, 105-ft. grade.

Aerating canal: conduit proper terminates about 2,500 ft. from distributing reservoir in paved channel 1,600 ft. long, having 16 overfalls, 10 ft. long, 2 ft. high, 3 ft. wide at bottom. Canal intersects two narrow ravines, and here water is carried through pipes.

Inlet to reservoir: from end of aerating canal 980 ft. 12-in. c. i. pipe leads to center of distributing reservoir, where it turns vertically, is carried up 1½ ft. above surface of reservoir, through pyramid of masonry 6 ft. sq. on top; water falls on top and sides of masonry "giving a final oxidation." Contrs., Sherman & McDonough, Troy. Cost of diverting dam and conduit, about $100,000.

Dam and Distributing Reservoir.—Cap., 25,000,000 galls.; area enclosed, 39¾ acres (not stated whether this is all flooded). Elevation, 583 ft above H. R. R. R. tracks in village. Depth, about 40 ft. at gate-chamber. To make slope of banks about 1¼ to 1, and secure at least 8 ft. of water, about 6,000 cu. yds. of slate rock was excavated, which was used in dam. Dam of limestone masonry, rock-faced, with earth embankment on lower side; curved, 20-ft. versed sine; masonry 340 ft. long on crest, 45 at bottom; 4½ ft. wide at water-line, which is 4 ft. below top of embankment, and 5 ft. below coping, which is 3 ft. wide and 1 ft. high. Wall has batter of 3 ins. to 1 ft. on upper side, vertical on lower, except at gate-chamber, where it has offsets. Embankment 16 ft. wide on top, with lower side sloping 3 to 1; top covered with 1 ft. quarry chips. Dam carried 23 ft. below natural surface to rock foundation, making masonry 63 ft. high. *Spillway:* 130 ft. from end of dam, excavated, lined with masonry, free; 20 ft. wide at bottom, 30 at top, 3½ ft. deep. *Gate-house:* rubble masonry, rock-faced, 30x32 ft., outside, 12x25 ft., inside, divided into three compartments by walls 3½ ft. thick. First compartment, nearest water, has two sets of screens from top to bottom of outer wall, and three inlet-pipes, with valves, 9, 18 and 27 ft. from water-surface, respectively. Second chamber is the filter. (See below.) From third chamber supply-mains lead to village.

Filter: 8x12 ft., x40 ft. deep, filled with coke. Water is admitted at top, from first compartment of gate-house, and passed through coke to space 5 ft. deep, below, connecting with third compartment. Screens, properly arranged, confine coke at top and bottom. To clean filter regular inlet is closed and supply carried from first compartment directly to third, through two 12-in. pipes. Water is then admitted through a 12-in. pipe at bottom of coke, passes up through to top, and is conducted to mud-pipe through a 12-in. vertical pipe.

Discharge-pipes: two 14-in. supply mains, leading from outer chamber; 12-in. mud-pipe leads from reservoir, through gate-house and embankment; 4-in. waste-pipe in third compartment connects with mud-pipe.

Supply Mains.—Discharge-pipes connect below dam, then divide into 14- and 12-in. mains, each about one mile long. *Pressure-reducing valves* were necessary on each line, as otherwise the head would have been 248 lbs. Valves were placed at 250-ft. head point, cutting out head of 200 ft. Valves are enclosed in substantial gate-houses.

Distribution.—*Mains*, c. i., 26½ miles. *Services*, lead. Pipes and specials from Warren Foundry & Machine Co., Phillipsburgh, N. J.; laid by T. Sullivan & Co. *Taps*, 640. *Meters*, Crown and Worthington, 26. *Hydrants*, Ludlow, 131. *Pressure-recording guage*, Edson. *Pressure-valves*, Ross.

Consumption, 1,000,000 galls. *Pressure*, 140 lbs.

Financial.—Cost, $305,000. Debt, $305,000: $30,000 at 3½, $275,000 at 3½ %. Ann. op. exp., $4,500. Ann. rev.: consumers, $13,590; city, $6,500. Hydrant rental, $50.

Management.—Comrs. Prest., Wm. J. Skinner. Secy., C. J. Palmer. Supt. and Engr., Stephen E. Babcock.

Reference.—"Construction and First Annual Report of the Board of Water Commissioners of Little Falls" gives more detailed description of the works, especially Chf. Engr. Babcock's report.

LITTLE VALLEY, *Cattaraugus Co.* (Pop., 566; est., 1,200.) Incorp. No sewers or electric lights.

History.—Built in '88 by village, under direction of Board of Trustees.

Water Supply.—Springs, by gravity.

Reservoir.—Cap., about 1,000,000 galls;

Distribution.—*Mains*, 6 and 4-in. w. i., 4½ miles. *Taps*, 115. *Meters*, none. *Hydrants*, Ludlow, 16.

Consumption, unknown. *Pressure*, 100 lbs.

Financial.—Cost, $12,500. Bonded debt, $12,500. Int., 4 %. Ann. op. exp., nominal; est., $100. Ann. rev.: consumers, $800.

Management.—Prest. and Supt., Saml. Dunham. Secy., Tint Champlin. Treas., D. F. Rundell.

LOCKPORT, *Niagara Co.* (Pop., 13,522; est., 18,000.) On Erie canal, which descends 60 ft. here, furnishing water-power used for manufacturing. On two plains, lower nearly level, upper 60 ft. above it, slightly back from bluff. Incorp. city in '65. Has sewers and electric lights.

History.—Built in '63 by city. Engrs. and Contrs., Holly Mfg. Co., Lockport, who put in rotary pump and 2 miles of 6 and 8-in. pipe for $17,000. These works were primarily built for fire protection. In '72, Holly Mfg. Co. contracted to put in a 1,500,000-gall. pump, and operate works for yearly rental of $1,500 and rents from consumers. Dec. 1, '82, the contract expired, and a 3-years' contract was made with Co., they to have yearly rental of $3,500, and city to furnish power at a cost of $1,500. City then, in '85, appointed Water Comrs., who elected a Supt.

Water Supply.—Erie canal, by direct pumping, water being drawn from canal through a tunnel.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; Gaskill water-power, with Holly boiler for reserve. A 2,000,000 Holly quadruplex was formerly used. In '89 contract was let for 5,000,000 Gaskill water-power pump.

Distribution.—*Mains*, c. i., 13½ miles. *Services*, w. i. *Taps*, 680. *Meters*, 10. *Hydrants*, Holly, 206. *Valves*, Holly.

Consumption, 1,800,000 galls. *Pressure:* Ordinary, 65 lbs. Fire, 80 lbs.

Financial.—Cost, $40,100. Bonded debt, $40,000. Int., 3½ %. Ann. op. exp., $10,063. Ann. rev.: consumers, $7,437; city, $5,000.

Management.—Comrs. Prest., R. B. Moor. Secy., W. P. Olmstead. Treas., Chas. Harrington. Supt., R. J. Sterrett.

LONG ISLAND CITY, *Queens Co.* (Pop., 17,129; est., 30,000.) On Long Island and East river, opposite N. Y. City, and adjoining Brooklyn. Has level surface. Engaged in manufacturing. Incorp. under its present name in '70.

History.—Built in '74 by city. Engr., Wm. E. Worthen, N. Y. City.

Water Supply.—Dug and driven wells, by direct pumping. First well is 50 ft. in diam., sunk 30 ft. in saturated sand; has 16-in. brick wall, resting on iron shoe, and was sunk by excavating inside and letting wall settle. In bottom of well three 4-in. pipes were driven down 20 ft. In '82 six 6-in. wells were driven 75 to 90 ft. deep, near by, and connected with suction pipe of pumps; these are used when necessary.

In '79 a second large well, 15 ft. in diam, 20 ft. deep, was sunk, 3 miles from first. Contr. for wells, Jno. Woodruff.

Pumping Machinery.—Dy. cap., not given; 2,000,000 Worthington, 3,000,000 Holly; Garrison, cap. not given.

Distribution.—(In '82.) *Mains*, 18 to 6-in. c. i., 16 miles. *Services*, galv. i. *Taps*, 1,050. *Meters*, 27. *Hydrants*, kind not given (in '88), 500.

Consumption, not given. *Pressure:* Ordinary, 45 lbs. Fire, 70 lbs.

Financial.—(In '82.) Cost, withheld, est., $400,000. Debt, withheld. Ann. op. exp., withheld, est., $6,000. Ann rev.: consumers, $37,000.

Management.—Water Comrs. Supt., P. J. Harrigan.

NOTE.—No later data regarding Distribution or Finances can be obtained, although personally solicited. Other data is correct to fall of '88.

LYONS, *Wayne Co.* (Pop., 3,820; est., 6,000.) On Clyde river. Has pottery and machine shops, pepperment oil distilleries, and manufactories of barrels and farm implements. Settled early in this century. Incorp. No sewers. Has electric lights.

FIRST WORKS.

In '77 small system for domestic supply was built by private Co., water being taken from springs and lifted to reservoir by pump driven by windmill. There was 1.5 miles of pipe, and 100 taps.

PRESENT WORKS.

History.—General supply introduced in '87 by Lyons Water-Works Co. Des. Eng., W. S. Parker. Const. Engr., Geo. Brandon. Contrs., Ryan & McDonald, Waterloo.

Water Supply.—Wells, pumping to stand-pipe.

Filter.—Unofficially reported that charcoal filter was to be added in '89.

Pumping Machinery.—Dy. cap., 1,800,000 galls.; Davidson.

Stand-Pipe.—Cap., 117,000 galls.; 20x50 ft.

Distribution.—*Mains*, 10 to 4-in. c. i., 9 miles. *Services*, w. i. *Taps*, 130. *Meters*, 4. *Hydrants*, Ludlow, 40. *Valves*, Ludlow.

Consumption, 90,000 galls. *Pressure*, 84 to 90 lbs.

Financial.—Cost, $100,000. No debt. Ann. op. exp., $2,460. Ann. rev.: consumers, $1,700; city, $1,600. Hydrant rental, $40, 5-years contract.

Management.—Prest., C. J. Ryan. Secy. and Treas., D. P. Foster. Supt., Edw. A. Browere.

MALONE, *Franklin Co.* (Pop., 4,193; est., 5,000.) On Salmon river, in undulating country. Has some manufactories. Settled in '05; incorp. village in '53. Partially sewered. Has electric lights.

History.—Built in '57 by Malone Water-Works Co., and extended in '88. Engr. for extensions, D. M. Greene, Troy. Contr., Edgarton Bynner, N. Y. City.

Water Supply.—Springs, by gravity to and from reservoir. Supply introduced in '88 from 3 springs, 8 miles from village.

Reservoirs.—Combined cap., about 1,600,000 galls. *Old:* cap., about 100,000 galls.; in embankment, 75 ft. above village; 60x30 ft., 8 ft. deep. *New Collecting:* 20x30 ft. *New Distributing:* cap., 1,500,000 galls; 200 ft. sq.; about 1¼ miles from village.

Conduit and Supply Main.—A 10-in. conduit, 8 miles long, leads from new collecting to distributing reservoir. Thence a 12-in. supply main, 1¼ miles long, leads to village.

Distribution.—*Mains*, 25 miles; old, w. i. and cem.; new, c. i. *Services*, not given. *Taps*, 1,000. *Meters*, none. *Hydrants*, 55.

Consumption, 250,000 galls. *Pressure*, 50 to 90 lbs.

Financial.—Cost, $140,000. Cap. stock, $75,000. Debt, $65,000: bonded, $50,000 at at 5: floating, $15,000 at 5 and 6%. Ann. op. exp., $1,200. Ann. rev.: consumers, $10,000; city, $2,500. Hydrant rental, $40.

Management.—Seven Comrs. Prest., Chas. W. Breed. Secy. and Treas., Lester C. Weads. Supt., Geo. Sabin.

MAMARONECK, *Westchester Co* (Pop., 1,863; est., 2,000.) On L. I. Sound; residence of N. Y. City business men. Imperfect sewers. No electric lights.

History.—Built in '85 by Mamaroneck Water Co. Engr., W. B. Rider, So. Norwalk, Conn.

Water Supply.—Mamaroneck river, pumping to reservoir.

Pumping Machinery.—Dy. cap., 250,000 galls.; Gaskill water-power. Small Worthington steam pump used prior to '89.

Reservoir.—Cap., 1,000,000 galls.; about 85 ft. above tide-water.

Distribution.—*Mains*, w. i., 6 miles. *Services*, c. i. *Taps*, 100. *Meters*, 10. *Hydrants*, kind not given, 14.

Consumption, 20,000 galls. *Pressure*, 80-ft. head.

Financial.—Cost, $65,000. Cap. stock, $30,000. Bonded debt, $30,000. Int., 6. Ann. op. exp., $1,200. Ann. rev.: consumers, $2,000.

Management.—Prest., Jas. M. Constable. Secy. and Treas., W. T. Cornell. Supt. and Engr., Louis Ottmann.

MANLIUS, *Onondaga Co.* (Pop., 834; est., 1,000.)

History.—Small system, date built not given, owned and kept in repair by parties along main.

Water Supply.—Springs, by gravity.

Distribution.—*Mains*, iron, ½ mile. *Services*, iron. *Taps*, 18. *Meters*, none. *Hydrants*, 4. Thirteen cisterns for fire protection.

Financial.—Cost about $500 for pipe and pipe-laying.

Management.—Prest., Chas. Hart. Secy., F. H. Dewy. Treas., Henry Whiting.

MATTEAWAN, *Dutchess Co.* See Fishkill & Matteawan.

MEDINA, *Orleans Co.* (Pop., 3,632; est., 5,000.) On Oak Orchard creek, which furnishes water-power used in various manufactories.

History.—Built in '60 by village for fire protection. Works for general supply have been projected. **Water Supply.**—Oak Orchard creek, direct pumping. **Pumping Machinery.**—Dy. cap., not given; Hawley. **Distribution.**—*Mains*, iron, 2 miles. *Hydrants*, kind not given, 20. *Pressure*, 125 lbs. **Financial.**—Cost, not given. No debt. Ann. op. exp., $500. **Management.**—(In '88.) Supt. G. E. Allen.

MIDDLETOWN, *Orange Co.* (Pop., 8,494; est., 9,000.) On Mohegan creek, in hilly region. Trade and manufacturing center. Settled 1755; incorp. village in '48. Has sewers built '89. Has electric lights.

History.—Built in '67 by village. Contrs., American Water-Works & Gas Pipe Co., now Ferris & Halladay, Jersey City, N. J. June 13, '89, taxpayers voted to build new reservoir, not to cost over $75,000.

Water Supply.—Springs and surface water, by gravity and pumping to reservoir. First supply was from impounding reservoir receiving drainage from 8 sq. m. This supply was insufficient and in '75 was supplemented by pumping from Shawangunk Kill through conduit.

Dam and Reservoir.—Cap., 3,000,000; area, 60 acres. Dam of earth, across narrow valley.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Holly quadruplex; 20-in. bore, 12-in. stroke.

Conduit.—Wooden, 12 ins. in diam. and 3½ miles long; made of 2¾-in. pine staves, banded with strap-iron, coated on outside with tar. Follows surface, descending 75 ft. below, and rising 25 ft. above, reservoir, yet though, owing to litigation, it was unused for 6 years, at end of period only three breaks occurred. In '89 conduit had become so badly out of order that it was decided to abandon it, as soon as reservoir could be built, rather than repair it.

Distribution.—(Feb. 1, '89.) *Mains*, wood, c. i. and cem., 17½ miles; 4 miles laid by Inman Bros., N. Y. City. *Services*, galv. i. *Taps*, about 920. *Meters*, 18. *Hydrants*, kind not given, 123.

Consumption, not given. *Pressure*, 55 to 85 lbs.

Financial.—(Feb. 1, '89.) Cost, $196,781. Bonded debt, $136,000: $36,000 at 4, $100,000 at 3½%. Sinking fund, $582. Ann. op. exp., $16,471. Ann. rev.: consumers, $17,872; city, none.

Management.—Water Comrs. Prest., Isaac R. Clements. Supt., I. F. Van Duzer. Clerk, D. F. Seward.

MORAVIA, *Cayuga Co.* (Pop., 1,540; est., 2,000.) Has manufactories. Incorp. No sewers or electric lights.

History.—Built in '84 by Moravia Water-Works Co. Des. Engr., S. H. Morgan.

Water Supply.—Springs, by gravity. Large storage reservoir was projected in '89.

Reservoir.—Cap., about 150,000 galls.

Distribution.—*Mains*, 10 to 4-in. c. i., 5 miles. *Services*, galv. i., black i. Pipe and specials from R. D. Wood & Co., Philadelphia, Pa., and Geo. B. Hayes. *Taps*, 120. *Meters*, none. *Hydrants*, Bailey, 30.

Consumption, not given. *Pressure*, 86 lbs.

Financial.—Cost, $40,000. Cap. stock, $30,000. Bonded debt, $20,000. Int., 6%. Ann. op. exp., $700. Ann. rev.: consumers, $1,000; city, $900. Hydrant rental, $30.

Management.—Prest., S. H. Morgan. Secy., A. A. Morgan. Treas. and Supt., Fred. C. Reynolds.

MOUNT MORRIS, *Livingston Co.* (Pop., 1,899; est., 2,500.) Engaged in manufacturing and agriculture. Settled in 1794; incorp. village in '35.

History.—Built in '79 by Mills Water-Works Co., under 30-years franchise. Engr., Byron Holly. Consult. Engr., J. Nelson Tubbs, Rochester.

Water Supply.—Nine springs, by gravity to and from reservoir. Springs crop out in area of 30 acres of fine sand, at base of hills of sandy loam, 1 mile west of village. Around, and 10 ft. from each spring 5-in. horse-shoe tile is laid 3 ft. below surface, conducting water to masonry and cem. wells, 3 ft. sq., 6 ft. deep. From settling wells 2-in. w. i. pipes carry water to a larger well, and from here ¾ miles of 4-in. pipe leads to a reservoir.

Reservoir.—Cap., est., 800,000 galls.; in excavation and embankment, 125 ft. sq. by 13 ft. deep; bottom and inner slopes paved with stone, grouted and plastered with cem.; masonry waste and supply chamber; flow-line 4 ft. above natural ground, 100 ft. above village.

Distribution.—*Mains*, c. i. 5 miles. *Services*, galv. i. *Taps*, 535. *Meters*, 15. *Hydrants*, Mathews, 25. *Valves*, Eddy, Ludlow.

Consumption, 75,000 galls. *Pressure*, 45 lbs.

Financial.—Cost, $60,000. Cap. stock, $60,000. No debt. Ann. op. exp., $750. Ann. rev.: consumers, $4,400; city, $1,125. Hydrant rental, $45.

Management.—Prest., Treas. and Supt., M. H. Mills.

MOUNT VERNON, *Westchester Co.* (Pop., 4,586; est., 11,000.) In township of East Chester, between Bronx and Hutchinson rivers: residence for N. Y. City business men, being 14 miles from that city. Has electric lights.

FIRST WORKS.

General Description.—In '83-4 works were built for domestic use, water being pumped from artesian well to stand-pipe. These works were bought by the present Co., and have been abandoned.

PRESENT WORKS.

History.—Built in '86 by New York & Mount Vernon Water Co., under 20-years franchise. Des. Engr., Geo. B. Inman, N. Y. City. Const. Engr., W. E. Allen. Contrs., Inman Bros., N. Y. City.

Water Supply.—Hutchinson's creek, pumping from impounding reservoir to stand-pipe.

Dam and Reservoir.—Cap., est., 45,000,000 galls. Reservoir, 400 x 1,500 ft., x 9 to 15 ft. deep. Site of reservoir excavated to gravel. Dam originally 440 ft. long, 12 ft. high, 8 ft. wide on top; in '88 or '89 it was raised 3 ft. Inner slope, 2 to 1, paved 1 ft. deep; outer, 1½ to 1. At site of dam ground consisted of about 2 ft. of muck, with 22 ft. of quicksand beneath. Sheet-piling was driven through quicksand and into blue clay below. *Heart-wall:* masonry, 2 ft. thick at base, 1½ at top, which is 1 ft. below top of bank; founded on concrete 4 ft. wide, extending to quicksand. *Spillway:* in dam, near end; 25 ft. wide, 3 ft. deep; masonry, 9 ft. thick at base, 5 at top. *Waste-pipe:* 20-in., with valve.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; Deane dup., comp., cond. A 2,000,000 Worthington under construction in '89. *Boilers:* two 50-H. P., built by Bigelow, New Haven, Conn.

Stand-Pipe.—Cap., 235,000 galls.; 20 x 100 ft.; to be raised by building stone foundation 25 ft. high; from Cunningham Iron Works, Boston.

Distribution.—*Mains*, 16 to 4-in. c. i., 26 miles. Pipe and specials from Warren Foundry & Machine Co., Phillipsburgh, N. J. *Taps*, 1,115. *Meters*, 26. *Hydrants*, Ludlow, 229; 8 being outside village. *Valves*, Ludlow.

Consumption, 500,000 galls. *Pressure*, 45 lbs.

Financial.—Cost, $525,000. Cap. stock, debt, int., not given. Ann. op. exp., withheld, est., $23,000; city, about $8,800.

Management.—Prest., G. E. Taintor. Treas., G. D. L'Huillier. Both of 11 Wall St., N. Y. City. Supt., E. H. Sheaff.

NEWARK, *Wayne Co.* (Pop., 2,450; est., 5,000.) In Arcadia township; location of car shops of the New York, West Shore & Buffalo R. R. Incorp.

History.—Built in '78 by Newark Water-Works Co. Engrs. and Contrs. Moffett, Hodgkins & Clarke, Syracuse, who control works.

Water Supply.—Springs, by pumping to stand-pipe from collecting reservoir.

Reservoir.—Capacity, 1,250,000 galls.

Pumping Machinery.—Dy. cap., 2,000,000 galls., two Worthington. *Boilers:* two 80 H. P. return tubular, steel.

Stand-Pipe.—Cap., 188,000 galls.; steel, 20 x 80 ft.; from Riter & Conley, Pittsburg, Pa.

Distribution.—*Mains*, c. i., 9 miles. *Services*, galv, i. *Taps*, 88, time of report. *Meters*, 2. *Hydrants*, 94; one at pumping station. *Valves*, Ludlow.

Consumption, 100,000 galls. *Pressure:* Ordinary, 67 lbs. Fire, 140 lbs.

Financial.—Cost, $120,000. Cap. stock, $100,000. Debt, $93,000. Int. 6%. Ann. op exp., $1,500. Ann. rev.: consumers, $4,600; city, $2,500. Hydrant rental, about $25.

Management.—Prest., J. F. Moffett. Secy., C. T. Moffett. Supt., F. W. Kellogg.

NEW BERLIN, *Chenango Co.* (Pop., 937; est., 1,200.) On Unadilla river; has large tanneries and flouring mills. Has electric lights.

History.—Built in '85 by village. Engr., W. S. Franklin, Johnstown. Contrs., Sherman & McDonough, Troy, now Troy Public Works Co.

Water Supply.—Springs and brooks, by gravity from impounding reservoir.

Dam and Reservoir.—Cap., 14,000,000 galls.; 25 ft. water. Dam of earth, with puddle heart-wall; about 30 ft. high. Inner slope, 3 to 1; outer, 2 to 1.

Distribution.—(In '87.) *Mains*, 10 to 4-in. w. i., 4 miles. *Services*, w. i. Pipe and specials from Warren Foundry & Machine Co., Phillipsburgh, N. J. *Taps*, 125. *Meters*, none. *Hydrants*, Ludlow, 23. *Valves*, Ludlow.

Consumption, 25,000 galls. *Pressure*, 115 lbs.

Financial.—(In '87.) Cost, $36,000. Bonded debt, $36,000. Int., 4%. Ann. op. exp., $50. Ann. rev.: consumers, $1,175.

Management.—Water Board. Prest. and Supt., G. G. Beers.

NOTE.—Inquiries sent in '89 ignored.

NEW BRIGHTON and PORT RICHMOND, *Richmond Co.* (Pop., New Brighton, 12,679; est., 16,000. Port Richmond, 3,561; est., 5,000.) On Staten Island, on shore of Kill Von Kull, on ground rising in terraces from water's edge. Population largely N. Y. City business men. Both incorp. Have sewers and electric lights.

History.—Built in '80-1 by Staten Island Water Supply Co. Engr. and Contr., Jno. Lockwood, N. Y. City. Consulting Engr., Wm. J. McAlpine, West New Brighton.

Water Supply —Forty driven wells, which syphon into large receiving well; by direct pumping and pumping to reservoir.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; 1,000,000 and 2,000,000 Knowles.

Reservoir.—Cap., 750,000 galls.

Distribution.—*Mains*, c. i., 40 miles. *Services*, lead, galv. i. Pipe and specials from Mellert Foundry & Machine Co., Reading, Pa., and Donaldson Iron Co., Emaus, Pa. *Taps*, 1,980. *Meters*, Crown, 30. *Hydrants*, Eddy, first used, now using Jonson, 309. *Valves*, kind, do.

Consumption, 1,800,000 galls. *Pressure*, 87 lbs.

Financial.—Cost, withheld, est., $375,000. Cap. stock, $200,000. Bonded debt $175,000. Int., 6%. Ann. op. exp., $20,000. Ann. rev.: consumers, about $28,000; cities, about $12,000. Hydrant rental, $40.

Management.—Prest., Horace Brightman, N. Y. City. Secy., J. T. Francis. Treas., H. L. Horton, 54 Broadway, N. Y. City. Supt., J. Seymour Warde, West New Brighton.

NEWBURGH, *Orange Co.* (Pop., 18,049; est., 20,000). On Hudson river, on steep slope of hill rising 300 ft. above river, with half of population less than 50 ft. above river. Engaged in hat, shoe, cotton, woolen, iron and other manufacturing, and boat-building. Incorp. city in '65. Has sewers and electric lights.

History.—Built in '53 by town. Des. Engr., Edwin French. Const. Engr., Peter Hogan, Albany.

Water Supply.—Washington lake and Silver creek, by gravity and pumping to reservoir. When full, Washington lake has area of 140 acres, and is 276 ft. above Hudson river. Drainage area about 1 sq. m. In '74 Silver creek was connected with lake by 1,864 ft. of 24-in. cem. pipe and 168 ft., presumably, of open channel.

Conduits.—From lake 3,128 ft. of 24, and for remaining distance 20-in. pipe leads to city. Also from natural outlet of lake 15-in. cem. and 18-in. vitrified stoneware pipe extends 2,000 ft. to natural subterranean passage, ¾ mile long, called Swallow-hole, and ending in Trout-hole reservoir. From here, 15,200 ft. of 2-in. pipe connects with other conduit at city; two conduits are also connected near reservoirs.

Reservoirs.—Cap. not given. *Trout-hole:* 200 ft. sq., 44 ft. below lake and 232 ft. above the Hudson. *High Service:* cap., 2,000,000 galls.; area, ¼ acre; 55 ft. above Washington lake, 101 ft. above Trout-hole reservoir, and 331 ft. above the Hudson. Banks of earth, 18 ft. high; water 2 ft. below top. Inner slopes 1½ to 1; cov-

ered with 6 ins. of concrete and 1 ft. of stone in Portland cement. Beneath bottom of bank trench 4 to 6 ft. deep was dug and filled with puddle. *Discharge-pipes:* 12-in. supply, 6 in. diam. Does not leak. Built in '86. Engr., Chas. Caldwell. Contrs., Truname & Chambers. Cost, $8,013.

Pumping Machinery.—Dy. cap., 864,000 galls.; Worthington.

Distribution.—*Mains*, c. i., 33 miles. *Services*, lead. *Taps*, 2,653. *Meters*, 5. *Hydrants*, Ayers, 245. *Valves*, Eddy. *Close of* '70: Mains, unknown. Taps, 509. Meters, none. Hydrants, 145. *Close of* '80: Mains, unknown. Taps, 1,751. Meters, none. Hydrants, 181.

Consumption, 2,000,000 galls. *Pressure*, not given.

Financial.—Cost, $524,108. Debt, $280,500: $75,000 at 7, $23,000 at 6, $67,000 at 5, $9,500 at 4, $68,000 at 4, $18,000 at 3½, $20,000 at 3%. Sinking fund, $80,300. Ann. op. exp., including all repairs, $10,602. Ann. rev.: consumers, $36,054. Cost in '70, $105,000: rev., $20,084. Cost in '80, $407,461; rev., $27,334.

Management.—Five Comrs. Prest., Jas. M. Crane. Secy. and Supt., Wm. C. Miller. Treas., J. P. Dickey.

NEW ROCHELLE, *Westchester Co.* (Pop., township, 5,276; est., village, 5,000.) Is 18 miles from N. Y. City. Incorp. No sewers. Has electric lights.

History.—Built in '85-7 by New Rochelle Water Co. Des. Engr., J. J. R. Croes, N. Y. City. Const. Engr., Chas. W. Hunt, New Rochelle.

Water Supply.—Hutchinson's river, by gravity from impounding reservoir.

Reservoir.—Cap., 100,000,000 galls.; area, 32 acres. Contr. for masonry and foundations, Wm. F. McCabe, Mamaroneck.

Distribution.—*Mains*, c. i., 22 miles. *Services*, lead. Pipe and specials from McNeal Pipe & Foundry Co., Burlington, N. J.; pipe laid by R. Dooley and Molloy Bros., New Rochelle. *Taps*, 265. *Meters*, 231. *Hydrants*, Galvin, 74. *Valves*, Ludlow. *Pressure-recording gauge*, Edson.

Consumption, 53,000 galls. *Pressure:* Ordinary, 30 to 70 lbs. Fire, do.

Financial.—Cost, $300,000. Cap. stock (in '87), $80,000. Bonded debt (in '87), $210,000. Int. not given. Ann. op. exp., withheld, est., $1,500. Ann. rev.: consumers, withheld, est., $9,000: city, $2,100. Hydrant rental, $30 each for 70.

Management.—Prest., Adrian Iselin, Sr. Secy, Henry Fatlo. Treas., A. Iselin, Jr. Supt., F. H. Davis.

NEW YORK, *New York Co.* (Pop., 1,206,209; est., 1,700,000.) Occupies tract about 2 miles wide and 16 long, its southern extremity, from Battery Park to Grand St., being a triangle of 1½ miles long with a base of 2 miles. From Grand St. north, 7 miles to Harlem, city lies between Hudson and East rivers. At Harlem, Harlem river flows diagonally across city to Spuyten Duyvil, on the Hudson, 13 miles from Battery. Northwardly from Harlem city is about 3 miles wide, bounded on the east for 8 miles by Bronx River, small freshwater stream. Lower portion of city slopes each way to rivers from Broadway, which is axis of city. In first mile from Battery, ground rises about 40 ft. and continues at nearly that elevation for 3 miles further, or to 30th street. There are 20 streets to mile. From 30th to 80th street elevation increases from 50 to 80 ft.; from 80th to 125th street, it is from 80 to 120 ft. on west side, east side being lower. Above 130th street and west of Harlem river, ground is from 150 to 200 feet high. North of Harlem river ground is irregular, varying in height from 10 to 280 ft. Has sewers and electric lights.

History.—In 1774, pop. being 22,000, comprised within 2 miles of battery, Christopher Collis, a civil engineer, constructed by order of Common Council, a reservoir east of Broadway, 1½ miles from Battery, and sunk a large well on the bank of the Collect, a stream near by. The work was stopped by Revolutionary War.

In 1799, pop. being 60,000, city subscribed for 2,000 shares of the Manhattan Co.'s stock, a corporation organized for banking and supplying water. This company constructed a well 25 ft. in diam. and 30 ft. deep, near the Collect, in what is now Centre, between Reade and Duane streets. Water was pumped to reservoir on Chambers street by two 18-H. P. steam engines. In '23, there were 25 miles of distribution pipe of bored logs, the engines were working 16 hours a day, and raising 691,200 galls., one-fifth more than cap. of reservoirs; 2,000 houses and several manufactories were supplied: pop. had increased to 150,000. Between '30 and '32 the company sunk a well, corner of Broadway and Bleecker street, 8 ins. in diam. and 442 ft. deep, through rock. Water rose to within 29 ft. of the surface, and 44,000 galls. were pumped dy. by a 6-H. P. engine.

In '30 city built works for Fire Department, consisting of well at 13th street, near Broadway, 16 ft. in diam., 112 ft. deep, 97 ft. being through rock. At 12 ft. from bot-

tom, two lateral galleries were run out, each 4 x 6 ft., x 75 ft. long, one having a branch 25 ft. long. Water rose in well to within 12 ft. of surface, which was 50 ft. above tide. A 12-H. P. engine pumped water into an iron tank 44 ft. in diam., 20½ ft. high, with bottom 83½ ft. above tide. Engines could run only three hours, twice a week, before exhausting supply, making an av. dy. yield of 10,428 galls. Before lateral galleries were driven water was very soft, afterwards very hard. Cost of works to Dec., '32, $42,233. A line of 12-in. c. i. pipe was laid from tank down Third avenue and Bowery to William street, with 10 and 6-in. branches in cross streets; in all, 34,726 ft., at a cost of $70,950. The supply of water at this time was so limited that 600 hogsheads were brought in from wells in the country, and sold at an av. price of $1.25, and 415 hogsheads were sent daily from Brooklyn to supply shipping, at a cost of $160. Hotels paid from $200 to $450, yearly, and boarding-houses from $15 to $50 for well water. In '34 the dy. yield of the 13th street well was increased to 21,000 galls. by boring in its bottom a 2½-in. hole, 100 ft. deep. About this time a well was dug near Jefferson Market, 16 ft. in diam., 30 ft. deep, from which an 8 H. P. engine with 7-in. pumps, forced water ¼ mile to 15th street tank.

In Feb., '35, Common Council had laid for fire service from tank, 74,888 ft. of 12, 10 and 6-in. c. i. pipe, had put in 61 stop-cocks, 176 fire hydrants, and 341 branches, at a total cost of $182,851, of which $162,636 was for material, and $20,215 for labor.

Mar. 11, '35, Major D. B. Douglas' plan for procuring water from Croton river was adopted by Common Council and afterwards ratified by popular vote of 17,330 to 5,963.

Work on Croton Aqueduct was soon begun, and water passed through it June 27, '42. This was first efficient general water supply introduced in N. Y. City, population then being about 375,000. Route of aqueduct was located and plans made by Maj. David B. Douglas, who was Chf. Engr. till Oct., '36, when he was succeeded by Jno. B. Jervis, who completed work after general design, but with modification of detail.

Sept. 4, '84, additional supply of water was introduced from Bronx river, supplying upper part of city, the 23rd and 24th wards, the surplus passing on to receiving reservoirs below. This work was done under direction of Geo. W. Birdsall, who was Acting Chf. Engr. of the Croton Aqueduct from Oct., '78, to Oct., '80, and then Asst. Chf. Engr. until his appointment as Chf. Engr.

In '83 Legislature passed act to provide new reservoirs, dams, and aqueduct, and appointed Aqueduct Commission. Aug. 15, '83, Benj. S. Church, who for 26 years had been Res. Engr. in charge of Croton Aqueduct, was appointed Chf. Engr. of Aqueduct Commission, and later, Jos. P. Davis, Consulting, Alphonso Fteley, Principal Assistant, and Henry S Craven, Const. Engrs. Apr. 9, '84, final plans for route of new aqueduct were adopted, and Dec., 13, '84, contracts for construction of portion between Croton and Harlem rivers were awarded; sections A and B to Heman Clark; 6, 7, 8 and 9 to O'Brien & Clark; 2, 3, 4 and 5 to Brown, Howard & Co.; and in 88 O'Brien & Clark were given the contract for pipe line between 135th street and Central Park, connecting masonry conduit with receiving and distributing reservoir. Ground for construction of Aqueduct was broken Dec. 30, '84. A description of new aqueduct and reservoirs, and progress of work, will be given further on.

For management and engrs. of works from '42 on see MANUAL for '88.

Water Supply.—Croton and Bronx rivers, by gravity from storage and impounding to receiving and distributing reservoirs. In '88 for high-service supply, dy. av. of 6,027,397 galls. was pumped to reservoir and tank at High Bridge, and 8,821,289 galls. to stand-pipe at 98th street.

Croton Supply.—Drainage area 338.82 sq. m. above Croton dam, from which aqueduct starts; southern limit is 40 miles from Battery; av. length, 25 miles; width, 13.5 miles. At point where water is taken valley of main stream is 120 ft. above tide-water, and rises to 450 ft. at head waters, while tributary streams rise from 300 to 600 ft., and surrounding hills from 400 to 1,000 ft. above tide. Surface of drainage area is broken and rocky, the rock being Laurentian gneiss, and a large part of area wooded. Minimum observed natural dy. flow of river, to '80, was recorded by Horatio Allen, Aug. 16, '38, as 31,663,872 galls., or 0.126 cu. ft. per second per sq. m. of drainage area. Maximum observed dy. discharge was in Apr., '84, est. at about 19,000 million galls., or exactly 74.87 cu. ft. per second per sq. m.

In '84 it was stated that the dy. flow over Croton dam varied from 10,000,000 to above 8,000,000,000 galls. The dy. consumption then being about 100,000,000 galls. necessity for additional storage is obvious.

Bronx Supply.—Drainage area, 13 sq. m. above reservoir at Kensico. Two storage reservoirs for this supply, Rye pond and Kensico. Water conveyed from latter 15.2 miles to distributing reservoir at Williamsbridge, in upper part of city.

Dams and Storage Reservoirs.—*Croton Lake:* cap., 5,000,000,000 galls.; above level at which aqueduct would discharge 35,000,000 galls. dy.; area, 400 acres. At head of aqueduct, first built with 90-ft. masonry overfall, rest being earth embankment. Jan. 7, '41, freshet occurred, overflowing and carrying away earth embankment. When rebuilt overfall of dam was made 270 ft. long. Foundation is two lines of cribs, filled with dry stone, with 10 ft. of concrete between. Upon this, broken range stone masonry was laid, down-stream side being curved, and faced with granite, the whole backed with earth. Below, a small crib dam, with planked apron, forms basin serving as water cushion to break shock of falling water. Dam, 40 ft. high; top 166 ft. above tide-water. The cost of this part of the work was about $9,000,000.

Boyd's Corner: cap., 2,727,000,000 galls. Built in '66-72; 23 miles from Croton dam, on west branch. Has cut stone faces filled between with concrete. Up-stream face vertical, down-stream face batters 4 ft. in 10. Extreme height from rock foundation, 78 ft.; top, 8.6 ft. wide, by 670 ft. long. *Spillway:* 135 ft. long, cut in rock at end of dam. In '70 earth embankment was added on up-stream side. Des. Engr., Geo. S. Greene.

Middle Branch: cap., 4,004,000,000 galls. Built in '74-8, on Middle branch of Croton. Earth, with center of rubble masonry carried to rock bottom. *Spillway:* cut in rock. Water drawn out through rock tunnel driven around end of dam. Des. Engr., E. H. Tracy.

Other Storage Basins, natural and artificial, with cap. in millions of galls., are: Lake Mahopac, 575; Lake Kirk, 565; Lake Gleneida, 165; Lake Gilead, 389; Lake Waccabuc, 200; Lake Tonetta, 50; Barrett's pond, 170; China pond, 105; White pond, 100; Pine pond, 75; Long pond, 60; Peach pond, 230; Cross pond, 110; Haines pond, 125; making with the Boyd's Corners and Middle branch reservoirs a total storage cap. in Croton drainage area of 9,400,000,000 galls. This will be increased to 14,000,000,000 galls. by completion of East branch reservoir, now under construction.

Bronx System of Storage Reservoirs: Rye pond covers 300 acres, is 16 ft. deep, and has cap. of 1,200,000,000 galls. Kensico reservoir covers 275 acres, is 30 ft. deep, and has cap. of 1,600,000,000 galls. Water was first drawn from latter in '84. As originally designed, dam was to be 45 ft. high and flood 250 acres at elevation of 200 ft. above tide water, with cap. of 100,000,000 galls.

Croton Aqueduct.—From dam at Croton lake to receiving reservoirs in Central Park. Masonry, brick-lined, bottom being inverted arch of 6.75 ft. chord, 0.75 ft. versed sine; sides, 4 ft. high, battered to 7.42 ft. apart, at top, and covered with semi-circular arch. Interior, 8.64 ft. high; sectional area, 53.34 sq. ft. Foundation concrete, side walls and spandrel backing, rubble masonry. Sectional area of masonry, 42.525 sq. ft. Top of masonry, 4 ft. underground. Embankments built 8 ft. wide on top, slopes 1½ to 1, with wall of dry stone rubble built up from natural surface to foundation level; high embankments have retaining walls of dry stone below spring of arch. This dry stone foundation settled, caused longitudinal cracks to appear from time to time, some of them being quite large. From '63-9 total length of cracks repaired was 34,271 ft. Length of the aqueduct, 38.1 miles; total fall, 43.7 ft.; ordinary grade, 1.1088 ft. a mile. Two deep valleys are crossed, Harlem river and Manhattan.

Harlem River Crossing: on granite masonry arched bridge; length between gate-houses, 1,393.38 ft.; elevation in clear, 100 ft. To save estimated extra expense of $500,000 bridge was placed at exact height required by law, 100 ft., and water carried across in two 36-in. pipes, 11 ft. lower than grade of aqueduct, with fall of 2.34 ft. It was supposed that these pipes would be large enough for 50 years, but in '60 it became necessary to increase cap. of this part of aqueduct. On floor of bridge c. i. standards were erected, 12 ft. apart, longitudinally, with planed tops 2½ ft. sq., upon which were three c. i. rollers, turned true, bearing c. i. saddles, base of each being 2½ ft. sq., planed. Saddles carry w. i. pipe, 7 ft. 6½ ins. in diameter, formed of plates ½ in. thick, 6 ft. long, 8 ft. wide before bending. Joints planed to radial lines, covered with ½ by 9-in. straps, having four rows of ¾-in. rivets, which were countersunk to interior surface of pipe. Built into and connecting each end of pipe with gate-houses is a slip joint, moving surfaces of which are faced with brass.

Temperature of water varying 50° between winter and summer, pipe contracts and expands about 6 ins. Large pipe kept painted inside and out. For protection from weather and convenience in crossing, pipe was covered over in such a way as

to make roof and footway. Chamber in which pipes are laid is 14 ft. sq., lighted from above. Capacity of three pipes equals that of the masonry part of the aqueduct. Des. Engr., Gen. Geo. S. Greene.

Manhattan Valley Crossing: two miles long, at first two 36-in. pipes, to which was added a 48-in. pipe in '53 and a 60-in. pipe in '61, latter being largest iron pipe cast up to that time. Pipes are straight cylinders; joints c. i., half sleeves, flanged and bolted.

Branch of Aqueduct and Changes: in '61 branch was built from 92d street to new reservoir, and in '65 portion below 92d street was replaced by two lines of 72-in. c. i. pipe. Of 486 lengths laid, 20 cracked soon after water was let in, generally at hub. A great number have broken since and have been repaired by banding them with w. i. straps. From '70-5 ¾ mile of masonry aqueduct within city was replaced by six lines of 48-in. pipe. Utmost safe dy. cap. of aqueduct has been called from 95- to 98,000,000 galls.

Bronx River Conduit.—From Kensico, or collecting reservoir, on river, to distributing reservoir at Williamsbridge; 15½ miles 48-in pipe; also 2½ miles of 36-in. pipe around receiving reservoir and to Jerome avenue.

Receiving and Distributing Reservoirs.—*Central Park, Old:* cap., 150,000,000 galls.; built before '40; 6 miles from Battery, 836 x 1,826 ft., x 20 ft. deep. Inner slopes lined with dry stone wall.

Central Park, New: cap., 1,200,000,000 galls.; built in '58-62, adjoining old; water area, 96 acres; depth, 36 ft. Irregular, being adjusted to topography. Banks of earth, slopes 1½ to 1, with puddle heart-wall extending from rock foundation 2 ft. above high-water level. In soft or disintegrated rock trench was excavated to solid material, filled with concrete, which was carried a few feet above bottom of puddle to form core. Inner slope of embankment faced with 8 ins. of concrete, on which is 18-in. paving of large stone laid in cem. This reservoir is also in two divisions, either one of which can be used alone. Influent and effluent gate-houses are of granite masonry, the chamber in the latter being separated from the pipe-vault by 6-ft. concrete wall, faced with brick. This wall leaking, reservoir was emptied, wall dried, washed with a solution of castile soap, followed by one of alum. Four coats were applied; wall has not leaked since.

Williamsbridge Reservoir.—Cap., 140,000,000 galls., having been enlarged recently; area, 15 acres; depth, 40 ft. Receives Bronx river supply and distributes it to extreme upper part of city.

Murray Hill Distributing Reservoir.—Cap., 24,000,000 galls.; 400 ft. sq. at water surface. Exterior walls, cut stone masonry, double, connected by arches. Earthen embankment placed against inner face, on which stone paving is laid.

Pumping Machinery.—*High Bridge Station:* dy. cap., 10,000,000 galls.; two 5,000,000, one built in '76, one in '84; latter Worthington. Supplies high-service reservoir and tank. *Ninety-Eighth St. Station:* cap., about 15,000,000 galls.; two Worthington, built in '79-80. Pumps to stand-pipe near by.

High Service Supply Reservoir.—Cap., 10,794,000 galls.; depth, 16 ft.; and flow-line 216.6 ft. above tide-level. Banks of earth with inner slopes paved with stone in cement.

Tank.—Cap., 47,000 galls.; connected with reservoir, iron; enclosed in an ornamental masonry tower, flow-line being 324 above tide-level.

Stand-Pipe.—At 98th street, 6 ft. in diam., 152 ft. high, base being 75 ft. above tide.

Islands in the East River, on which are penal and charitable institutions, are supplied through submerged pipe. Randall's and Ward's islands were first supplied in '46 through two 3, and one 3¼-in. lead pipe, laid in wooden trunks on bottom of the river. In '50 flexible gutta-percha pipe was laid across irregular bottom of river to Blackwell's island. In '52, '61 and '70 these pipes were broken and replaced, the latter time by 3-in. w. i. pipes. In '71 these were broken and replaced by one 6-in. lap-welded w. i. pipe, joints made with heavy screen couplings, and strengthened by c. i. sleeves with leaded joints. Pipe was 1,350 ft. long, put together on land, inclosed in a bolted and riveted oak case, space around pipe filled with cement, box saturated with coal tar, and hauled across river into place by chains from a steam capstan. Pipe and box weighed 200 tons, and were laid in 100 ft. of water. Similar pipes were laid to Ward's island in '71, to Randall's island in '76, and a 10-in. pipe across Harlem river to annexed district in '74. In '69 an 8-in. pipe, lined with 1 in. of wood to prevent water in the pipe from freezing, had been laid to Randall's island. The breaks in the gutta-

percha pipe were caused by the giving away of anchors, allowing pipe to move back and forth on the rough bottom till worn out, and by dragging of ship's anchors, tearing the pipes apart. In '87 6-in. c. i. pipe was laid across to Blackwell's and North Brother islands.

Distribution.—*Mains*, c. i., 638 miles. *Services*, w. i., lead. *Taps*, about 180,000. *Metres*, Crown, Worthington, Thompson, Gem, 18,211. *Hydrants*, Ayres, 7,984.

Consumption, 112,370,000 galls.: 95,000,000 from Croton, 17,370,000 from Bronx river supply. *Pressure:* Ordinary, 10 lbs. Fire, 20 lbs. *Pressure-recording gauge*, Edson.

Financial.—Cost, $39,231,662: $35,332,948 for Croton; $3,908,714 for Bronx and Byram supplies. These figures do not include amount expended on New Croton Aqueduct, except for surveys, plans, specifications and inspection of such part of the work as interferes in some way with the old supply. Debt, $5,537,400; as near as can be ascertained from Comptroller's Report for '88. Ann. op. exp., $421,453. Ann. rev.: consumers, $2,602,794.

Management.—Comr. of Public Works, Thos. F. Gilroy. Chf. Engr., Geo. W. Birdsall. Water Purveyor, Wm. H. Burke. Registrar, Jos. Riley.

New Croton Aqueduct.—Line as adopted Apr. 9, '84, begins at Croton dam on Croton river, runs south along Pocantico and Saw Mill river valleys, across Harlem river to north side of Manhattan valley at 135th street. Harlem river is crossed by inverted syphon, and water conveyed through 8 large mains from 135th street, four going to reservoir in Central Park and four branching off to connect directly with distribution. Elevation at Croton river, 110 ft. above tide-level. Length from Croton dam to Central Park Reservoir, 33⅛ miles; fall, 33.8 ft. For first 24 miles interior of conduit has cross-sectional area, giving cap. equal to circular conduit 14 ft. in diam. At this point conduit begins to be on a hydraulic grade, so area is reduced to equal a circular conduit 12¼ ft. in diam., and at north side of Harlem river, is reduced to circular conduit 10½ ft. in diam. Latter reduction is on account of taking out from 80,000,000 to 100,000,000 galls. to supply the 23d and 24th wards from distributing reservoir to be built at or near Jerome Park. Cross-section of conduit varies according to location, pressure, and material through which it passes.

There are four waste-weir gate-houses; first at Pocantico river near Tarrytown, 9⅛ miles south of beginning of conduit;, second at Saw Mill river, 6¼ miles further south, near Ardsley; third at Tibbett's brook, 5⅛ miles below second; the fourth at Harlem river. There are three gate-houses for controlling and regulating supply through aqueduct, one each at Croton dam, 135th street, and Central Park.

Shafts are located along line from 6,200 to 7,800 ft. apart. In its length from Croton lake to Harlem the tunnel grade twice reaches level of ground, and these points constitute open portals, numbered as shafts, that at Pocantico being No. 9 and at Tibbett's brook, No. 18. At Ardsley, tunnel is near enough surface to discharge its contents, if desired, through a culvert, and at High bridge it can be emptied into Harlem river, far below ground, through tunnel. At these four points the waste-weirs, described above, are located.

In connection with construction of new aqueduct it was deemed necessary to build three new dams and storage reservoirs, known as Quaker Bridge, Muscoot and Sodom.

Dec. 23, '85, the Commission resolved to build the Sodom dam, on the East branch of the Croton river. This is now under construction. In '89 contract was let to Jno McQuade for dam on Muscoot branch Croton river; price, $540,610. This dam will be described in our next issue.

There has been much discussion regarding the building of the Quaker Bridge dam, but no decision as late as Mar. 25, '90. If built as planned it will form a reservoir with a storage cap. of 30,000,000,000 galls.

References.—In addition to those given in MANUAL for 1888, as follows:

Tenth Census U. S., Vol. XVII., Water Supply of Cities, pp. 5-17.

Century for Dec., '89, "The New Croton Aqueduct," illustrated; by Chas. Barnard.

Harper's Weekly, Dec. 14, '89, "The New Aqueduct—The Sodom Dam;" illustrated.

ENGINEERING NEWS, Vol. XXI., p. 444, description and illustration, 6-in. flexible joint on sub-marine line to North Brother's Island; Vol. XXI., p. 505, "Potable Water Supply of the City of New York;" a review of State Board of Health Report.

"Report on the Potable Water Supply of the City of New York." Extract from 8th Ann. Rept. State Board of Health. Many illustrations. Relates to Croton watershed and contamination of same.

NEW YORK MILLS, *Oneida Co.* (Pop., 902.)

General Description.—The New York Mills have a small system chiefly for the use of their mills. Spring water is furnished to a few families for domestic use. Water is pumped direct to mains from 3 reservoirs on Sanquint creek, having a combined cap. of about 1,000,000 galls. *Mains*, iron, 2 miles. *Hydrants*, 51. *Pressure*, 150 lbs.

NIAGARA FALLS, *Niagara Co.* (Pop., 3,320; est., 5,000.) On Niagara river, adjoining the Falls, village being on level ground. Summer resort; several manufactories. Settled in 1759; incorp. in '48. Partially sewered. Has electric lights.

History.—A distributing plant built in '77 by Niagara Falls Water-Works Co. Engr., Ben. J. Rhodes.

Water Supply.—From Suspension Bridge water-works.

Distribution.—*Mains*, c. i., 7½ miles. *Services*, w. i. *Taps*, 501. *Meters*, none. *Hydrants*, kind not given, 56.

Consumption, 500,000 galls. *Pressure:* Ordinary, 65 lbs. Fire, 120 lbs.

Financial.—Cost, $49,795. Cap. stock, paid in, $47,200. Debt, none. Ann. op. exp., $6,025, including $641 for taxes. Ann. rev.: consumers, $6,821; city, $2,800. Hydrant rental, $50. Suspension Bridge receives 40% of gross receipts, included in op. exp.

Management.—Prest., W. F. Evans. Secy., Benj. Rhodes. Treas., F. R. Deland. Supt., H. S. Ware.

NORTH TARRYTOWN, *Westchester Co.* (Pop., 2,684.) In township of Mount Pleasant, one mile from Tarrytown. Manufactures shoes and edge-tools. Incorp. Partially sewered. Has electric lights.

History.—Built in '88 by Pocantico Water-Works Co., under 30-years franchise, to supply North Tarrytown, Dobb's Ferry and Hastings-upon-Hudson. Engr., A. L. Betts. Contr., J. M. Low, Kingston.

Water Supply.—Pocantico river, by direct pumping and pumping from impounding to distributing reservoir.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; 2,000,000 Deane and 1,000,000 Gordon & Maxwell. A 1,000,000-gall. water-power pump, driven by 55-H. P. Risdon turbine was formerly used.

Reservoirs.—Combined cap., 130,000,000 galls.; a 120,000,000 and 10,000,000.

Distribution.—(Nov. 1, '89.) *Mains*, c. i., 23 miles. *Services*, rustless i. *Taps*, 300. *Meters*, none. *Hydrants*, 105: 38 in N. Tarrytown, 43 in Dobb's Ferry, 24 in Hastings-upon-Hudson.

Consumption, 200,000 galls. *Pressure*, 150 lbs.

Financial.—Cost withheld, est., $400,000. Cap. stock, $500,000. Bonded, $250,000. Hydrant contracts: $50 each for 10 at North Tarrytown, 20 at Dobb's Ferry, 20 at Hastings; additional, $40.

Management.—Prest., J. M. Low, Kingston. Secy., Chas. H. Smith. Treas., Thos. J. Lawrence. Supt. and Engr., A. L. Betts.

NORTH TONAWANDA, *Erie Co.* See Tonawanda.

NORWICH, *Chenango Co.* (Pop., 4,553; est., 5,500.) On Chenango river, at mouth of Cemasawacta creek. Two high ridges are separated by Chenango valley, one rising 500 ft. Engaged in manufacturing. Settled in 1788; incorp. in '16. No sewers. Has electric lights.

History.—Built in '81 by Norwich Water-Works Co. Engr., P. H. Baermann, Troy. In '89 surveys were made and right of way acquired for new reservoir.

Water Supply.—Hopkins' brook, with 4 miles drainage area, by gravity from impounding reservoir.

Dam and Reservoir.—Cap., 30,000,000 galls.; area, 8 acres; 35 ft. deep, 180 ft. above village. Dam of earth, with heart-wall, on rocky foundation; 40 ft. high, 323 ft. long, 10 ft. wide on top. Inner face riprapped. *Heart-wall:* puddled clay. *Spillway:* at one end, in rock, lined with masonry, free; slope, 5 ft. *Discharge-pipe:* 16-in. Dam does not leak. Des. Engr., P. H. Baermann, Troy. Const. Engr., W. F. Franklin, Lansingburg. Contrs., Tubbs & Decker.

Filter.—Water is drawn from reservoir through 24-in. vertical pipe, with drain tile at base for filter.

Supply Main.—C. i., 8,200 ft. long.

Distribution.—*Mains*, c. i., 11 miles. *Services*, w. i. *Taps*, 332. *Meters*, 2. *Hydrants*, kind not given, 27. *Pressure-recording gauge*, Edson.

Consumption, not given. *Pressure*, 73 lbs.

Financial.—Cost, $100,000. Cap. stock, $50,000. No bonds. Debt, $15,000. Int., 5%. Ann. op. exp., withheld, est., $1,000. Ann. rev.: consumers, est., $6,000; city, $972. Hydrant rental, $36.

Management.—Prest., Jno. Mitchell. Secy., T. DeWitt Miller. Treas., Cyrus B. Martin.

NUNDA, *Livingston Co.* (Pop., 1,037; est., 1,200.) Has machine shops, foundries, furniture and wagon factories. Incorp. No sewers or electric lights.

History.—Built in '86-7 by Nunda Water Co.

Water Supply.—Springs, by gravity, and pumping to reservoir for reserve.

Distribution.—*Mains*, Wyckoff wood, 7 miles. *Taps*, 30. *Meters*, not given. *Hydrants*, kind not given.

Consumption, about 60,000 galls. *Pressure:* Fire, 75 lbs.

Financial.—Cost, $25,000. Debt, none. Ann. op. exp., $200. Ann. rev.: consumers, $300; city, $1,000. Hydrant rental, $45.

Management.—Prest., Miles Ayrault. Sec., U. H. Willard.

NYACK, *Rockland Co.* (Pop., 3,881; est., 6,500.) On west bank of Hudson river, on steep and rocky ground. Manufactures shoes and hats. Incorp. village in '83. No public sewers. Has electric lights.

History.—Built in '73 by Nyack Water-Works Co. Engr., Wm. Voorhis.

Water Supply.—Springs and Hackensack river, by gravity and pumping to reservoir

Reservoirs.—Six: combined cap., 2,000,000 galls. Five smaller reservoirs receive water from springs; four have cap. of 60,000 galls. each. Larger reservoir receives water pumped from river, is two miles from and 275 ft. above it, and 300 ft. above village; in excavation, with lining of stone in cem ; has cap. of 1,000,000 galls.

Filter.—River water is filtered by passing through two apartments filled with charcoal, and one with sponge.

Pumping Machinery.—Dy. cap , 600,000 galls.; Blake dup., with 18-in. steam and 9-in. water cylinders, 18-in. stroke.

Force Main.—C. i , 8-in.; 2 miles long.

Distribution.—*Mains*, c. i., 13 miles. *Services*, w. i. *Taps*, 425. *Meters*, 1. *Hydrants*, Mathews, 33, *Valves*, McLean, Ludlow.

Consumption, about 80,000 gallons. *Pressure*, 55 lbs.

Financial.—Cost, about $180,000. Capital stock, $100,000. Bonded debt, $50,000. Int., 6%. Ann. op. exp., including construction, $10,000. Ann. rev.: consumers, $9,500; city, $1,500. Number of hydrants not limited.

Management.—Prest. and Treas., Wm. Voorhis. Secy., A. M. Voorhis. Supt. Wm. L. Voorhis.

OAKDALE, *Suffolk Co.* See Islip.

OGDENSBURGH, *St. Lawrence Co.* (Pop., 10,341; est., 11,000.) On St. Lawrence at mouth of Oswegatchie river, 72 miles below Lake Ontario. Summer resort; engaged in commerce and manufacturing. Founded in '49; incorp. village in '17, city in '68. Has sewers and electric lights.

History.—Built in '68 by city. Engr., G. W. Pearsons, Kansas City, Mo.

Water Supply.—Oswegatchie river, direct pumping.

Pumping Machinery.—Cap., 8,000,000 galls; 5,000,000 Lang pump, other not given; a 2,000,000 Holly water-power, with auxiliary boilers, formerly used.

Distribution.—*Mains*, c. i., w. i. and cem., 16 miles. *Services*, galv. i. *Taps*, 1,400. *Meters*, none. *Hydrants*, Mathews, 91.

Consumption, 1,000,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 85 lbs.

Financial.—Cost, $135,000. Bonded debt, $135,000: $35,000 at 7, $100,000 at 3½%. Ann. op. exp., $5,553. Ann. rev.: consumers, $10,979; city, $5,000.

Management.—Comrs. Chn., W. M. Baird. Supt., A. B. Lord.

OLEAN, *Cattaraugus Co.* (Pop., 3,036; est., 9,000.) On Allegheny river. Has oil and manufacturing interests. Incorp. village in '54. Has sewers and electric lights.

History.—Built in '78 by village, and rebuilt and extended in '83, under superintendence of S. D. Miller.

Water Supply.—Well, pumping to reservoir. Well 25 ft. in diam., 16 ft. deep; has 20 3-in. pipes driven 15 ft. in bottom, and is connected with Allegheny river, for emergency supply, by 12-in. c. i. pipe.

Pumping Machinery.—Dy. cap., 2,800,000 galls ; Worthington dup., with 14x20-in. steam, 10-in. water cylinders; also 2,000,000 Gaskill horizontal added in '89.

Force Main.—C. i., 12-in., 2,000 ft. long.

Reservoir.—Cap., 2,500,000 galls.; in excavation and embankment, 230 to 250 ft. above village; 65 ft. sq. at bottom, 20 ft. deep, with side slopes 1½ to 1, puddled with 18 ins. of clay and lined with brick. Earth embankment 10 ft. high divides it in two compartments.

Distribution.—*Mains*, c. i., 11.7 miles. *Services*, w. i. *Taps*, 714. *Meters*, 4. *Hydrants*, Ludlow, 83. *Valves*, Ludlow.

Consumption, 650,000 galls. *Pressure*, 90 lbs.

Financial.—Cost, $85,254. Debt, $77,500: $65,000 at 4½, $12,500 at 4%. Sinking fund, none. Ann. op. exp., $5,887. Ann. rev.: consumers, $8,135; city, $3,625.

Management.—Three Comrs. Prest., James F. Johnson. Secy. and Supt., John Z. LeFever.

ONEIDA, *Madison Co.* (Pop., 3,934; est., 6,000.) In Lenon township. Has manufactories. Incorp. No sewers. Has electric lights.

History. Built in '83 by Warner Water-Works Co., under 50-years franchise. Engr., J. W. Warner.

Water Supply.—Large springs, by gravity from impounding reservoir.

Dam and Reservoir.—Cap., 22,350,000 galls.; area, 6½ acres; depth at dam, 28 ft.; 190 ft. above, and 2¾ miles from village. Dam not described.

Distribution.—*Mains*, c. i., 12 miles. *Services*, lead. *Taps* (in '87), 300. *Meters*, none. *Hydrants*, Mathews, 73. *Valves*, Ludlow.

Consumption, not given. *Pressure*, 80 lbs.

Financial.—Cost, $142,000. No debt. No further data given. *Estimates:* Ann. op. exp., $800. Ann. rev.: consumers, $10,000.

Management.—Prest. and Supt., J. W. Warner. Secy., I. C. Chapin. Treas., D. Chapin.

ONEONTA, *Otsego Co.* (Pop., 3,002; est., 8,000.) On Oneonta creek, on hilly ground. Engaged in trade and manufacturing. Incorp. Has sewers and electric lights.

History.—Built in '82 by Oneonta Water-Works Co. Engr., W. B. Rider, So. Norwalk, Conn. Contrs., Inman Bros., N. Y. City.

Water Supply.—Oneonta creek, by gravity from impounding reservoir,

Dams and Reservoirs.—Combined cap., 520,000,000 galls. *First:* cap., 20,000,000 galls.; area, 7 acres. Dam of earth with stone heart-wall; 150 ft. long, 30 ft. high. *Second:* cap., 500,000,000 galls. Dam of earth, with masonry heart-wall; 60 ft. high, length not given; nearly 400 ft. thick at bottom. Inner part embankment puddled. slopes 3 to 1. Now has 35 ft. water, which can be increased to 50 ft. by building dam across ravine, thus shutting off overflow. Contrs., Sherman & McDonough, Troy, now Troy Public Works Co.

Filter.—Sponge and charcoal, at outlet chamber of dam.

Distribution.—*Mains*, c. i., 12 miles, *Services*, w. i. *Taps* (in '87), 425. *Meters*, 6. *Hydrants*, Mathews, 58. *Valves*, kind, do.

Consumption, not given. *Pressure*, 65 lbs.

Financial.—Cost, about $200,000. Cap. stock, $160,000. Bonded debt, $30,000. Int., 5 and 6%. Ann. op. exp., withheld, est., $1,200, Ann. rev.: consumers, withheld, est., $18,000; city, about $1,700. Hydrant rental, $30

Management.—Prest., Munro Westcott. Secy., Jas. Stewart. Treas , E. A. Scramling. Supt., T. A. Norton.

OSWEGO, *Oswego Co.* (Pop. 21,116; est., 24,000.) On northern shore of Lake Ontario, at mouth of Oswego river. City on both sides river, from which ground rises about 200 ft. River is dammed for manufacturing purposes and slack-water navigation, affording good water-power. Has extensive flour and starch manufactories, and considerable commerce. Incorp. Has sewers and electric lights.

History.—Built in '68 by Oswego Water-Works Co. Engr., Wm J McAlpine, deceased.

Water Supply.—Oswego river, pumping to reservoirs. River has drainage-area of about 3,000 sq m., including 7 of the largest interior lakes in State.

Pumping Machinery.—Dy. cap., 4,500,000 galls.; Kingsford water-power.

Reservoirs.—Combined cap., 15,000,000 galls.; one reservoir on each side of river, east being 191 ft. and west, 155 ft. above lake. Both in excavation and embankment, in two divisions, with sand and gravel filter in partition wall.

Distribution.—*Mains*, c. i., 38 miles. *Services*, w. i. *Taps*, 1,265. *Meters*, 40. *Hydrants*, Stover, N. Y. pattern, 193. *Valves*, Ludlow.

Consumption, 3,000,000 galls. *Pressure:* Ordinary, 20 to 70 lbs. Fire, 50 to 75 lbs.

Financial.—Cost, $521,000. Cap. stock, $229,500. Debt, $297,000. Int., 5 to 7%. Sinking fund, $60,000. Ann. op. exp., $16,500. Ann. rev.: consumers, $13,250; city, $15,000, for hydrants and 18 drinking fountains.

Management.—Prest., T. S. Mott. Secy., H H. Lyman. Treas., J. F. Mott. Supt., Thos. H Bennett.

OSWEGO FALLS, *Oswego Co.* (Pop., 1,831; est., 2,200.) On Oswego river, 12 miles from Oswego. Manufacturing village.

History.—Supplied in 85 from works at Fulton.

Distribution.—*Mains*, c. i., 2½ miles. *Services*, not given. *Taps*, 70. *Meters*, 1. *Hydrants*, kind not given, 20.
Consumption, unknown. *Pressure*, 55 lbs.
See Fulton for further details.

OTEGO, *Otsego Co.* (Pop., est., 1,200.) In agricultural region. Some manufactories. Not incorp. No sewers or electric lights.

History.—Built in '89 by Otego Water Co.; put in operation about Oct. 1. Engr., J. Warren Lamb, Cooperstown.

Water Supply.—Otsdawa creek and springs, by gravity.

Reservoir.—Cap., 40,000 galls.

Distribution.—*Mains*, 6 and 4-in. c. i., 3½ miles. *Services*, galv. i. Pipe from Jackson & Woodin Mfg. Co., Berwick, Pa. *Hydrants*, Mathews, 13. *Valves*, Eddy. *Pressure*, 75 lbs.

Financial.—Cost, $17,000. Cap. stock, $21,000. No debt. Hydrant rental, $30.

Management.—Prest. W. H. Parker. Secy. and Treas., Lottie A. Field, Cooperstown. Gen. Mgr., J. Warren Lamb, Cooperstown.

OWEGO, *Tioga Co.* (Pop., 5,525; est., 6,000.) On Owego creek at its junction with Susquehanna river, in hilly region. Engaged in lumber trade and manufacturing. Incorp. village. Has sewers and electric lights.

History.—Built in '79 by Owego Water Co., under 10-years franchise. Engr., S. L. Wiley, Omaha, Neb. Contrs., Wiley Construction Co. In '75 surveys and plans were made for town by Isaac S. Cassin, Philadelphia.

Water Supply. Barnes creek, filtered, by gravity from impounding to distributing reservoir. Creek is mountain stream with drainage area of about 3 sq. m. Auxiliary supply by pumping from well, seldom used.

Dam and Impounding Reservoir.—Cap., about 70,000,000 galls.; area, 12.39 acres; 2½ miles from, 235 ft. above, village. Dam of clay, on rock, with heart-wall; 250 ft. long, 60 ft. high, with water 5 ft. below top. Inner slope 2½ to 1, riprapped; outer, 2 to 1, *Heart-wall:* masonry, dimensions not given. *Spillway:* at west end of dam, in rock, planked on bottom, masonry on sides, free; 75 ft. wide; slope, 2 ins. to 1 ft. *Discharge-pipe:* 24-in.; level. Dam does not leak badly. Date built, Engr.' and Contr., see History. Cost, about $20,000.

Conduit.—To distributing reservoir; 12-in. c. i.

Distributing Reservoir.—Cap., est., 750,000 galls.; 150 x 70 ft., x 10 ft. deep; paved slopes; on hill near town.

Filter.—Dy. cap., 325,000 galls.; Hyatt; on supply main at distributing reservoir Erected in Aug., '87.

Pumping Machinery.—Dy. cap., 500,000 galls.; Deane.

Distribution.—*Mains*, c. i., w. i., 11½ miles. *Services*, w. i. *Taps*, 427. *Meters*, 19. *Hydrants*, Mathews, 57.
Consumption, 296,000 galls. *Pressure*, 100 lbs.

Financial.—Cost, $136,000. Cap. stock, $80,000. Bonded debt, $80,000. Int., 6%. Ann. op. exp., about $2,900. Ann. rev.: consumers, withheld, est., $10,000; city, $2,850. Hydrant rental, $50.

Management.—Prest., S. L. Wiley, Omaha, Neb. Secy., Treas. and Supt., Geo. Y. Robertson.

OXFORD, *Chenango Co.* (Pop., 1,209.) On Chenango river. Has some manufactories.

General Description.—Individuals bring spring water in 1¼-in. iron pipe, and sell same for domestic use. Dam on stream, and ½ mile of pipe supply fountain in park. Holly pump, driven by power from mill. ½ mile of 4-in. iron pipe, and 7 cheap hydrants are used for fire protection. Report made by D. B. Smith.

PALMYRA, *Wayne Co.* (Pop., 2,308; est., 3,500). Is 23 miles from Rochester. Trade centre. Incorp. village.

History.—Built in '89-90 by Palmyra Water-Works Co.; completed and tested Feb. 7. City has option of buying at end of 5 years. Engrs. and Contrs., Basset Bros., Buffalo.

Water Supply.- Surface well, pumping to stand-pipe. Well is about 20 ft. it diam., 20 ft. deep, with brick walls.

Pumping Machinery.—Dy. cap., 1,200,000 galls. *Boilers:* two 40-H. P.

Stand-Pipe.—Cap., 200,000 galls.; steel; on Prospect Hill, about 1,000 ft. from pumps.

Distribution.—*Mains*, 10 to 4-in. c. i., 5 miles. Services, galv. i, rustless i. *Taps* (Dec. 21), 40. *Meters*, Crown, 12. *Hydrants*, Ludlow, 40. *Valves*, Ludlow. *Pressure:* Ordinary, 75 lbs. Fire, 125 lbs.

Financial.—Cost, not given, est., $90,000. Cap. stock, $50,000. Debt and int., withheld. Hydrant rental, $40; 10-years contract.

Management.—Prest., C. M. Harrington. Secy., E. M. Bassett. Both of Buffalo. Treas., C. R. Bassett, N. Y. City. Supt., R. A. Vandeboget. Date of latest report, Feb. 19, '90.

PATCHOGUE, *Suffolk Co.* (Pop., est., 5,000.) Engaged in manufacturing, fishing and oyster business. Incorp. Partially sewered. Has electric lights.

History.—Built in '87 by Suffolk County Water Co., under a 50-years franchise. Engr., Jno. Lockwood. Contr., Jno. C. Lockwood. Both of N. Y. City.

Water Supply.—Six-in. pipe wells, 40-ft. deep, pumping to stand-pipe.

Pumping Machinery.—Dy. cap. 1,500,000 galls.; two 750,000 Gaskill dup.

Stand-Pipe.—Cap. 235,000 galls.; 20 x 100 ft.; made by Southwark Foundry & Machine Co., Philadelphia, Pa.

Distribution.—*Mains*, c. i., 4½ miles. *Services*, galv. i. Pipe from Warren Foundry & Machine Co., Phillipsburgh, N. J., and specials from Builders' Iron Foundry, Providence, R. I. *Taps*, 125. *Meters*, not given. *Hydrants*, Holly, number not given. *Valves*, Holly.

Consumption, 500,000 galls. *Pressure*, 40 to 100 lbs.

Financial.—Cost, $105,000. Cap. stock, $60,000. Bonded debt, $40,000. Int., 6%. Ann. op. exp., withheld. est., $1,200. Ann. rev.: consumers, withheld, est., $7,000. Hydrant rental, $40.

Management.—Prest., Jno. Lockwood, N. Y. City. Secy. and Treas., Jno. C. Lockwood. Supt., Saml. A. Souther.

PEEKSKILL, *Westchester Co.* (Pop., 6,893; est., 7,000.) On east bank of Hudson river, on very irregular and steep hillsides. Has several iron foundries. Incorp. in '16. Has sewers and electric lights.

History.—Built in '75 by city. Engr., Chas. E. Fowler.

Water Supply.- Van Cortland creek, pumping to reservoir. Drainage area, about 5 sq. m., the formation of which is mostly slate, with some gneiss overlying limestone.

Pumping Machinery.—Dy. cap., 660,000 galls.; Vergennes water-power; auxiliary engine. *Water-wheels:* two American turbines.

Reservoir.—Cap., 36,000,000 galls.; formed by building two dams across outlets of old basin having gently sloping sides, basin being excavated 6 ft. below original surface, making depth of water 16 ft.; area, about 5 acres. Dams of earth, from excavation; inner slopes of reservoir, 1½ to 1. Arrangements are made for direct service during repairs to reservoir and for drawing out water at 2½ ft. below surface.

Distribution.—*Mains*, c. i., 10¼ miles. *Services*, galv. i., rubber-coated i. *Taps*, 670. *Meters* (In '87), 58. *Hydrants*, Mathews, 87.

Consumption, about 300,000 galls. *Pressure:* Ordinary, 140 lbs. Fire, 160 lbs.

Financial.—Cost, $153,000. Debt, $153,000. Int., 4 and 7%. Ann. op. exp., about $13,000. Ann. rev.: consumers, $7,921; city, $5,980.

Management.—Five Comrs. Prest., Jas. T. Sutton. Secy., Frederick Lent. Treas., F. M. Dain. Supt. Orrin J. Loder.

Reference.—*Eng. News*, vol. VIII., pp. 341-2.

PENN YAN, *Yates Co.* (Pop., est., 2,500. In townships of Benton and Milo, at outlet of Lake Keuka, which furnishes water-power used in extensive manufactories. Settled in '14; incorp. village in '33.

History.—Built in '84 for fire protection. Pumps owned by Russell & Birkett; pipe and hydrants by village. **Water Supply.**—Outlet of Lake Kenka, by direct pumping. Lake is from ½ to 1 mile wide, and 22 miles long. **Pumping Machinery.**—Dy. cap., about 200,000 galls.; Holly. **Distribution.**—*Mains*, ½ mile. *Hydrants*, from Commercial Iron Works Co., Penn Yan, 16. *Valves*, kind, do. *Pressure*, 60 lbs. **Financial.**—Cost, about $2,000. Village pays stated sum for pumping, amount not given. **Management.**—Supt., W. F. Saunders.

PHELPS, *Ontario Co.* (Pop., 1,369; est., 1,700.) On Flint river and Canandaigua lake, 8 miles from Geneva. Has manufactories. Incorp. village.

History.—Built in '69 by Phelps Water-Works Co.; put in operation Sept. 1, '80. Engrs. and Contrs., Bassett Bros., Buffalo.

Water Supply.—Springs, by gravity.

Distribution.—*Mains*, c. i., 1½ miles. *Services*, galv. i., rustless i. *Taps*, 20. *Meters*, Crown, number not given. *Hydrants*, Ludlow, number not given *Valves*, Ludlow.

Pressure, 65 lbs

Financial —Cost, withheld, est., $50,000. Cap stock, $20,000. Debt, int., and hydrant rental, withheld.

Management.—Prest., C. M. Harrington. Secy., E. M Bassett. Both of Buffalo. Treas, C. R Bassett, N. Y. City. Supt., W. D. Norton. Date of report, Dec. 21, '89.

PHŒNIX, *Oswego Co.* (Pop., 1,312; est., 2,500.) On Oswego river, 15 miles from Syracuse. Has good water-power, partly used for manufacturing. Incorp. No sewers. Has electric lights.

History.—First supplied in '79. Following report describes works completed in '88 by Phœnix Water Co. Des. Engrs., Bassett Bros., Buffalo. Const. Engr., J. I. Van Doren, Phœnix. Contrs. for masonry, William Patrick; for buildings, J. I. Van Doren; for pipe-laying, W. A. Walters; all of Phœnix.

Water Supply.—Oswego river, wells and springs, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; Volker & Felthousen (or Buffalo) dup. water-power. *Boiler:* for reserve; from American Iron Works, Oswego.

Stand-Pipe.—Cap., 188,000 galls.; 20x80 ft.; from Riter and Conley, Pittsburg, Pa.

Distribution.—*Mains*, 8 to 4-in. c. i., 6 miles. *Services*, galv. i. Pipe and specials from Warren Foundry & Machine Co., Phillipsburgh, N. J., laid by W. A. Walters, Phœnix. *Taps*, 100. *Meters*, none. *Hydrants*, Ludlow, 25. *Valves*, Ludlow.

Consumption, 100,000 galls. *Pressure:* Ordinary, 65 lbs. Fire, 150 lbs.

Financial.—Cost, $80,000. Cap. stock, $40,000. Bonded debt, $40,000. Int., 6%. Ann. op. exp., $500. Ann. rev.: consumers, $2,000; city, $1,125. Hydrant rental, $45; 30-years contract.

Management.—Prest., J. I Van Doren. Supt., Secy. and Treas., Van R. Sweet.

PLATTSBURGH, *Clinton Co.* (Pop. 5,245.) On Lake Champlain and Saranac river. Engaged in manufacturing and lake commerce. Has electric lights.

History.—Built in '70 by village.

Water Supply.—Surface water, by gravity from impounding and distributing reservoirs; former is about 6, and latter about 2 miles from village. Drainage area, 20 sq. m.

Reservoirs.—Cap., not given. *Impounding:* cap., 3,450,000 galls.; area, 3 acres; av. depth, 6 ft. *Distributing:* not described.

Conduit and Supply Main.—Two lines of pipe connect reservoirs, each about 4 miles long. Supply main about 2 miles long.

Distribution.—*Mains*, c. i., cem., 15 miles. *Services*, iron. *Taps*, not given, est., 400. *Meters*, none. *Hydrants*, 68.

Consumption, 500,000 galls. *Pressure*, 86 lbs.

Financial.—Cost (In '81), $180,000. Ann. op. exp. (in '87), $4,336. Ann. rev.: consumers (in '87), $16,360.

Management.—Three Comrs. Supt., A. Williams.

PORT BYRON, *Cayuga Co.* (Pop., 1,146; est., 1,500.) At outlet of Owasco Lake. Engaged in manufacturing. Settled in 1797; incorp. a village in '37. No sewers or electric lights.

History.—Built in '72 by village. Village owns water right of 28 H. P.; balance above that needed for pumping given to manufacturer for running pumps.

Water Supply.—Well, pumping to reservoir

Pumping Machinery.—Dy. cap., 100,000 galls.; water-power; from Rumsey & Co., Seneca Falls. See History.

Reservoir.—Cap., 800,000 galls.; 160 ft. above business, 30 to 40 ft. above highest resident part of village.

Distribution.—*Mains*, c. i., 3 miles. *Services*, c. i. Pipe from Camden Iron Works, Camden, N. J.; laid by Wm. Jones, Port Byron. *Taps*, about 60. *Meters*, none. *Hydrants*, Mathews, 26.

Consumption, 5,000 galls. *Pressure*. 60 lbs.

Financial.—Cost, about $12,000. No debt. Ann. op. exp., about $100, for repairs. Ann. rev.: consumers, $250.

Management.—Trustee, Jno. L. Davis.

PORT CHESTER, *Westchester Co.* (Pop., 3,254; est., 6,000.) Has iron and other manufactories. Has electric lights.

History.—Distribution built in '84 by Port Chester Water-Works Co. Rye and Harrison also supplied. Engr., Wm. B. Rider, So. Norwalk, Conn.

Source of supply, reservoirs, tanks and filters owned by Greenwich (Conn.) Water Co.

Distribution.—*Mains*, c. i. (in '87), 20 miles. *Services*, w. i., lead. *Taps*, about 600. *Meters* (in '87), 14. *Hydrants*, Mathews, 60. *Valves*, Chapman, Ludlow.

Pressure. 118 lbs.

Financial.—All data withheld, save hydrant rental, $25. *Estimates:* Cost, $200,000. Ann. op. exp., $1,000. Ann. rev.: consumers, $15,000; city, $1,500.

Management.—Prest., J. W. Lowesburgh. Secy., J. W. Diehl. Supt., Jno. Dayton, Greenwich, Conn.

NOTE.—All other data included under Greenwich, Conn.

PORT JERVIS, *Orange Co.* (Pop., 8,678; est., 10,000.) On Delaware river, on irregular ground. Engaged in manufacturing. Incorp., village. No sewers. Has electric lights.

History.—Built in '70 by Port Jervis Water-Works Co. Des. Engr., Jno. B. Jervis, deceased. Const. Engr., H. H. Farnum.

Water Supply.—Surface water, by gravity from storage reservoirs.

Dams and Reservoirs.—Combined cap., 450,000 galls. *Upper:* cap., 250,000 galls.; area, 20 acres; elevation, 450 ft. above village. Dam of earth with plank and timber heart-wall. Water discharged over dam by siphon, and flows in channel of stream to lower reservoir, about 3 miles below. *Lower:* cap., 200,000,000 galls.; area, 17 acres; elevation, 135 ft. above lowest point in village. Dam of earth, plank and timber heart-wall. *Spillway:* no data. *Discharge-pipe:* 16 in.

Supply Main.—Diam., 12 ins.

Distribution.—*Mains*, c. i., 6 miles. *Services*, galv. i., lead. *Taps*, 800. *Meters*, none. *Hydrants*, Mathews, Gloucester, 136. *Valves*, Ludlow.

Consumption, 1,200,000 galls. *Pressure:* Ordinary, 58 lbs. Fire, 75 lbs.

Financial.—Cost, $125,000. Cap. stock, $45,000. Bonded debt, $20,000. Int., 5%. Ann. op. exp., $2,000. Ann. rev.: consumers, $10,000; city, $2,250. Hydrant rental, about $15.

Management.—Prest., Peter E. Farnum. Secy., W. H. Crane. Treas., Wm. E. Scott. Supt., E. H. Ellis.

PORT RICHMOND, *Richmond Co.* See New Brighton.

POTSDAM, *St. Lawrence Co.* (Pop., 2,762; est., 3,800.) On Racket river. Engaged in lumber and other manufacturing, and quarrying sandstone. Incorp. Has sewers and electric lights.

History.—Built in '71 by village. Engr., G. W. Pearsons, Kansas City, Mo.

Water Supply.—Racket river, by direct pumping. River has drainage area of 30 sq. m.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; two Holly, water-power. In '89 auxiliary steam pump was projected.

Distribution.—*Mains*, w. i. and cem., 4½ miles. *Services*, w. i. *Taps*, 350. *Meters*, none. *Hydrants*, Mathews, 36. *Valves*, Eddy. *Close of '80:* Mains, 4 miles. Taps, 230. Meters, none. Hydrants, 36.

Consumption, 225,000 galls. *Pressure:* Ordinary, 55 lbs. Fire, 100 lbs.

Financial.—Cost, $50,000. Debt, $47,000. Int., 7%. Ann. op. exp., $1,000. Ann. rev.: consumers, $4,000. Cost, in '80, about $47,000; rev., $3,000.

Management.—Village Clerk, S. C. Crane. Supt., W. F. P. Sealy.

POUGHKEEPSIE, *Dutchess Co.* (Pop., 20,207; est., 22,000.) On Hudson river on ground rising rapidly from river to plateau 150 to 200 ft. high, and at College hill to 378 ft. Settled in 1690; incorp. city in '54. Has sewers and electric lights.

History.—Built in '70 by city, when population was 20,080. Engr., J. B. S. Rand. Consult. Engr., James P. Kirkwood. Both deceased.

Water Supply.—Hudson river, pumping to settling basin, from which water passes through filters to reservoir, and is pumped to distributing reservoir.

Inlet Pipe.—To pump-well; first a box conduit, which was changed in '77 to 107 ft. of 24-in c. i. pipe, in box, filled round with concrete.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two Worthington comp., cond., one for filter bed, and one for main pumping.

Settling Basin and Filters.—Water surface of former 30 ft. above mean level lower pump-well; 25 x 60 ft., x 12 ft. deep, and in three compartments. Two filter beds, each 73½ x 200 ft., x 12 ft. deep, with 6 ft. of filtering material arranged as follows: 24 ins. sand, 6 of ¼-in. gravel, 6 of 2-in. broken stone, and 24 of 4 to 8-in. broken stone, resting on concrete floor, on which are open stone culverts conveying filtered water to an intermediate basin, 6 x 85 ft., x 16 ft. deep. From this it passes to reservoir, 28 x 88 ft., x 17 ft. deep, and from here by 408 ft. of 18-in. pipe, to main pump under head of about 17 ft. above induction valves.

Filter beds cost $54,000. Cost of removing ice, cleaning beds and washing sand in '88 was $809; cost per million galls., $1.32; cost repairs, $86.

Force Main.—C. i., 18-in., 7,700 ft. long.

Reservoir.—Cap., 12,000,000 galls.; on College hill, 280 ft. above mean water-level of pump-well; in excavation and embankment, 210 x 540 ft., x 11½ ft. deep, with puddle heart-wall and puddled bottom covered with 3 ins. of coarse gravel.

Distribution.—*Mains*, c. i., 18.61 miles. *Services*, lead. *Taps*, 1,852. *Meters*, Worthington, Crown, Empire, 652. *Hydrants*, Mathews, 319. *Close of '80:* Mains, 16.86 miles. Taps, 1,326. Meters, 122. Hydrants, 293.

Consumption, 1,669,358 galls. *Pressure*, 40 to 120 lbs.

Financial.—Cost, $584,641. Debt, 550,000. Int., 7%. Sinking fund, $7,469. Ann. op. exp., $18,875. Ann. rev.: consumers, $25,937. Cost close of '80, $572,388; rev., $19,117.

Management.—Six Comrs. Prest., Daniel Gourley. Supt., Chas. E. Fowler.

Reference.—Tenth Census U. S., vol. XVII., Water Supply of Cities, pp. 167-171.

PRATTSVILLE, *Greene Co.* (Pop., est., 600.) On Schoharie creek, in Catskill mountains. Incorp. No sewers or electric lights.

History.—Built in '85 by Prattsville Water Co., under 10-years franchise. Des. Engr., W. B. Rider, So. Norwalk, Conn. Const. Engr. and Contrs., Norwalk (Conn.) Water Pipe & Const. Co.

Water Supply.—Huntersfield stream, by gravity.

Distribution.—*Mains*, 6-in., 2 miles; from Contrs. *Services*, tarred i. *Taps*, 18. *Meters*, none. *Hydrants*, Ludlow, 10. *Valves*, Ludlow.

Financial.—Cost, $7,000. Debt, not given. Ann. op. exp., $50. Ann. rev.: consumers, $150; city, $250. Hydrant rental, $25.

Management.—Prest. and Treas., Francis Leonard, Norwalk, Conn. Supt. and Secy., Martin Chamberlain.

PULASKI, *Oswego Co.* (Pop., 1,501; est., 1,800.) On Salmon river, 4 miles from Lake Ontario. Engaged in manufacturing. Incorp. village. No sewers or electric lights.

History.—Built in '87 by village. Engr. E. D. Smalley, Canastota. Contr., G. W. White, Pulaski.

Water Supply.—Spring brook, direct pumping from impounding reservoir.

Reservoir.—Cap., not given; area, about 5 acres.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Gaskill water-power.

Distribution.—*Mains*, c. i., 3 miles. *Services*, not given. *Taps*, 150. *Meters*, none. *Hydrants*, kind not given, 30.

Consumption, 6,000 galls. *Pressure:* Ordinary, 20 lbs. Fire, 80 lbs.

Financial.—Cost, about $30,000. Debt, $27,500: $25,000 bonds, $2,500 floating. Int., 4%. Ann. op. exp., $200. Ann. rev.: consumers, $900.

Management.—Prest. and Supt., Dr. F. S. Low. Secy., A. W. Dunn. Treas., W. F. Austin. Supt E. D. Fitch.

RANDOLPH, *Cattaraugus Co.* (Pop., 1,111; est., 1,500.) Engaged in manufacturing and lumber trade. Incorp. No sewers or electric lights.

History.—Built in '85 by village. Engr., E, A. Curtis, Fredonia. Contrs., Chambers & Casey, Rochester.

Water Supply.—Spring, by gravity.

Dam and Reservoir.—Cap., 500,000 galls.; 80 x 160 ft.; bottom, natural clay, sloping 3 ft. in 200. Dam of clay and dirt with heart-wall; 80 ft. long, 12 ft. high, 12 ft. wide on top, 36 at bottom; inner part has perpendicular wall for 4 ft. from bottom, then slopes and is paved. *Heart-wall:* puddled clay, 2 ft. thick at top and bottom, extending to top of bank. *Spillway:* at end, lined with plank, free; 6 ft. wide; slope, about 1 ft. in 6. *Discharge-pipe:* 10-in., with gate. Dam does not leak. Designed by S. L. King and G. E. Seager. Contr,, S. L. King. Both of Randolph. Cost, $1,250.

Distribution.—*Mains*, c. i., 4½ miles. *Services*, w. i., lead, Pipe and specials from Ormrod, Fisher & Co., Emaus, Pa. *Taps*, 160. *Meters*, none. *Hydrants*, Ludlow, 18. *Valves*, Ludlow.

Consumption, unknown. *Pressure*, 97 lbs.

Financial.—Cost, $20,450. Debt, $20,000. Int., 4%. Ann. op. exp., "about $2 for stationery, etc." Ann. rev.: consumers, $1,120; city, $900. Hydrant rental, $50.

Management.—Secy, and Supt., G. E. Seager.

RICHFIELD SPRINGS, *Otsego Co.* (Pop., 1,307; est., 3,000 permanent, and 5,000 in summer.) In hilly country, near Schuyler lake, and has sulphur springs, making it summer resort. Incorp. Has sewers and electric lights.

History.—Built in '79 by Richfield Springs Water-Works Co. Engr., P. H. Baermann, Troy. Contrs., Sherman & Flagler, Utica, now Troy Public Works Co. For new supply: Engr., E. D. Smalley, Canastota; Contrs., Sullivan & Wilkerson, Syracuse.

Water Supply.—Creek, filtered, pumping to reservoir. Supply formerly from Allen's lake.

Pumping Machinery.—Dy, cap., 1,000,000 galls; Worthington.

Filters.—Cap., 500,000 galls.; Hyatt; erected Apr., '88.

Dams and Reservoir.—Cap., 9,000,000 galls.; area, 4 acres. Dam of earth with heart-wall; 100 ft. long, 20 ft. of water. Inner slope, 3 to 1, with 10-in. paving; outer, 1½. *Heart-wall:* puddle. *Spillway:* 15 ft. from end of dam, 60 ft. long; lined with masonry, controlled by gates; slope, 1 ft. in 10. *Discharge-pipes:* two, 8 and 12-in.; slope 1 ft. in 6. Dam does not leak. Date built, Engr. and Contr., see History. Cost, $10,000. There are two other smaller dams, not described.

Distribution.—*Mains*, c. i., 5 miles. *Services*, w. i. *Taps*, 215. *Meters*, none. *Hydrants*, kind not given, 35.

Consumption, 250,000 galls. *Pressure:* Ordinary, 85 lbs. Fire, 85 lbs.

Financial.—Cost, $50,000. Bonded debt, $43,500: $23,500 at 6, $20,000 at 5%. Sinking fund, $800. Ann. op. exp., $1,000. Ann. rev.: consumers, $3,800.

Management.—Prest., V. Palmer. Secy., H. C. Watson. Treas., N. Getman. Supt., J. P. Crim.

ROCHESTER, *Monroe Co.* (Pop., 89,366; est., 130,000.) On Genesee river, 7.3 miles from, and 263 ft. above, Lake Ontario. On both sides river which, in passing through city, has 3 falls of 96, 26 and 83 ft. respectively. City built on limestone rock, and both river and well water is very hard. Engaged in commerce, nursery business and manufacturing, having large number of flouring mills. Settled in '12; incorp. city in '34. Has sewers and electric lights.

History.—Built in '72-6 by city. Engr., J. Nelson Tubbs. Contr., Jas. McDonald, Willsborough Falls.

Water Supply.—Hemlock and Canadice lakes and Genesee river, by gravity to storage and distributing reservoirs; from Genesee river, by direct pumping, for independent supply in business parts of town, for fire protection and hydraulic motors Water is taken from Hemlock lake, 28 miles south of city, and 388 ft. above Erie canal in city; 6.7 miles long, 0.6 miles wide, from 45 to 90 ft. deep; area, 2.15 miles; drainage area, 42.39 miles; in valley surrounded by steep hills, soil of which is underlaid by shale; water very soft. An additional conduit has been projected for construction in '90.

Canadice lake is in a valley east of and joining Hemlock valley; 3.1 miles long, ⅛ of a mile wide; drainage area, 1 sq. m.

Hemlock Lake Intake Crib.—Timber, 1,000 ft. from shore, in 36 ft. of water; 12 ft. sq., 9 ft. high, made of 6 x 12-in. oak and pine, bolted together with bottom of 3-in oak planks; top covered with wire screen. Crib is loaded with stone.

Conduit.—First 700 ft. from inlet crib laid in trench by means of coffer dams. Next comes three sections 97, 100 and 74½ ft. long, connected with ball and socket joints, outer end of last section being funnel shaped. These sections were laid on timber platforms. For this distance, and continuing from shore for 49,776 ft., the conduit is 36-in. w. i., with fall of 47 ft.; then comes 1,918.65 ft. of w. i., 30,549.75 ft. of c. i., 13,809.38 ft. of w. i. and 5,222 27 ft. of c. i. pipe, all 24-in. Here gate-house of Rush reservoir is reached, the flow-line of reservoir being 143 ft. below Hemlock lake and 242 ft. above city datum. Conduit follows surface of ground, which in some places is 340 ft. below hydraulic grade line. In '79 break occurred in 24-in. c. i. pipe and several joints were reported as being started.

Rush Storage Reservoir.—Cap., 74,525,992 galls; area, 13.87 acres; depth, 19 ft.; 10 miles from city hall: in excavation and embankment. Banks are 23¼ ft. high, above bottom of reservoir, 16 ft. wide on top, with water 4¼ ft. below top. Inner slope, 2 to 1, with level break 5 ft. wide 11¼ ft. from top; is covered for 12 in. with gravel, then for 1½ ft. with riprap; outer, 2½ to 1. Bottom has 18 ins. of puddle, covered with 8 ins. of gravel. *Heart-wall.*—Puddle, carried 10 ft. below bottom, within 2 ft. of top of bank; 10 ft. thick for 8 ft. above bottom, then 6 ft. thick for 12 ft. *Discharge-pipes:* two; 24-in. Reservoir does not leak badly. Engr. and Contr., see History. Cost, $130,000.

Conduit to Distributing Reservoir.—C. i., 24-in.; 46,064 ft. long; has fall of 127 ft.

Mount Hope Distributing Reservoir.—Cap., 24,278,000 galls.; area, 5.52 acres; depth, 15 ft.; ¾ mile from city hall; construction similar to Rush reservoir; flow-line, 124.4 feet above Erie canal in city. Banks 20 ft. high from bottom of reservoir, 16 ft. wide on top. The 24-in. influent pipe enters masonry gate-house in center of reservoir, and discharges upward under head of 127 ft., forming a fountain jet. Influent pipe can be connected with the 24-in. effluent, giving increased pressure in city in case of fire. This is done at every fire alarm. Reservoir does not leak badly. Engr. and Contr., see History. Cost, $150,000.

Genesee River Crossing.—Two compartments of c. i., 3x3 1-6 ft., each containing two 12-in. w. i. pipes of ¼-in iron were carried, each branching at each end from an 18-in. c. i. pipe with slip joints. Pipes over bridge are packed in fine charcoal to prevent freezing.

Pumping Machinery.—Cap., 7,000,000 galls.; Holly. *Boilers:* steel; from Woodbury Engine Co.

Distribution.—*Mains*, c. i., w. i., 205 miles. *Services*, lead. Pipe and specials from B. S. Clark, N. Y. City. *Taps*, 21,000. *Meters*, 1,800. *Hydrants*, Mathews, 1,913. *Valves*, Ludlow. *Pressure-recording gauge*, Edson. *Close of '80*: Mains, 112.8 miles. Hydrants, 979.

Consumption, 10,750,000 galls. *Pressure:* Ordinary, 35 to 85 lbs. Fire, 112 lbs.

Financial.—Cost, $3,989,123. Debt, $3,182,000. Int., 7%. Sinking fund, none. Ann. op. exp., $30,000. Ann. rev.: consumers, $200,000: city, $100,000. Cost close of '80, $3,419,749; rev., $96,693.

Management.—Water Board. Prest., Jas. M. Akenkead. Secy., Thos. J. Neville. Supt. and Engr., J. Nelson Tubbs.

Reference.—Tenth Census U. S., Vol. XVII., Water Supply of Cities, pp. 154-160.

ROCKAWAY BEACH, *Queens Co.* See Far Rockaway.

ROME, *Oneida Co.* (Pop., 12,194; est., 14,000.) On Mohawk river, at junction of Black river and Erie canal, on level ground. Manufactures knit and iron goods, saddles and locomotives. Incorp. No sewers. Has electric lights.

History.—Built in '73 by city. Engr., Peter Hogan, Albany.

Water Supply.—Mohawk river at point two miles above city, pumping to reservoir and direct pumping in case of fire.

Pumping Machinery.—Dy. cap., 5,000,000 galls.; pumps designed by Chas. W. Knight, Rome, and built in '85 by Watertown Steam Engine Co. *Water-wheels:* turbine added in '83, by S. Morgan Smith, York, Pa.

Reservoir.—Cap., 9,000,000 galls.; 330 ft. in diam., 25 ft. deep. 60 ft. above pumps. Contr., David French, Syracuse.

Distribution.—*Mains*, c. i., w. i. and cem., 16 miles; w. i. and cem. pipe is fast being replaced with c. i. *Services*, lead. *Taps*, 1,050. *Meters*, none. *Hydrants*, kind not given, 147. Pipes, specials, valves and hydrants furnished, and pipe laid by American Water & Gas Pipe Co., now Ferris & Halladay, Jersey City, N. J.

Consumption, 2,000,000 galls. *Pressure:* Ordinary, 20 lbs. Fire, 60 lbs.

Financial.—Original cost, $160,000. Bonded debt, $160,000, due in '92. Int., 7%. Ann. op. exp., $9,858. Ann. rev.: consumers, $15,470; city, none.

Management.—Comrs. Supt., Theo. S. Comstock.

ROUND LAKE, *Saratoga Co.* (Pop., winter, 300; summer, 1,500.) Near Saratoga; summer resort.

History.—Built in '87 by Round Lake Assn. Engrs., Landreth & Fitzgerald, Schenectady. Contr., Benj. Van Vranken, Schenectady.

Water Supply.—Springs, collected in reservoir, pumping to tanks.

Collecting Reservoir.—Cap., 100,000 galls.; in excavation, 30 x 80 ft. at top. Inner slopes covered with 1 ft. of clay puddle, then paved with selected stones and finally riprapped. Engr. and Contr., C. D. Hammond. Cost, $2,000.

Pumping Machinery.—Dy. cap. not given; two pumps.

Force Main.—Size and length not given; rises 100 ft.

Tanks.—Two; cap., 35,000 galls. each.

Supply Main.—Diam., 6 ins.; length ½ mile.

Distribution.—*Mains*, c. i., 1½ miles. *Services*, c. i. All houses supplied. *Hydrants*, 14.

Consumption, 40,000 galls. *Pressure*, 50 lbs.

Financial.—Withheld. *Estimates:* Cost, $7,000. Ann. op. exp., $300. Ann. rev., $500.

Management.—Supt., Jno. D. Rogers.

ROUSE'S POINT, *Clinton Co.* (Pop., 1,485; est., 3,000.) Incorp. village. No sewers or electric lights.

History.—Built latter part '89 by village. Engr., F. S. Pecke, Watertown. Contrs., Brown Bros., Mohawk.

Water Supply.—Lake Champlain, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Worthington comp.

Stand-Pipe.—Cap., 148,000 gals.; 15 x 112 ft.; from Phœnix Foundry & Traction Co., Syracuse.

Distribution.—*Mains*, 10 to 4-in. c. i., 3½ miles. *Hydrants*, Galvin, 40. *Valves*, Galvin.

Financial.—Cost, $26,444. Bonded debt, $24,000; $1,000 20-year bonds, int. payable semi-annually. Int., 4%.

Management.—Three Comrs. President, Jno. Phillips. Secy., Wm. Turner. Date of latest report, Nov. 22, '89.

RYE, *Westchester Co* (Pop., not given.) About 1½ miles from village of Port Chester, which see.

SAG HARBOR, *Suffolk Co.* (Pop., est., 3,000.) On Long Island, 100 miles from N. Y. City. Engaged in commerce and manufacturing. Incorp. village. No sewers or electric lights.

History.—Built in '89 by Sag Harbor Water Co.; put in operation in Oct. Engr., Chas. K. Moore, N. Y. City.

Water Supply.—Wells, pumping to stand-pipe.

Pumping Machinery.—Dy cap., 1,000,000 galls.; Worthington.

Stand-Pipe.—Cap., 235,000 galls.; 20 x 100 ft.; from Tippett & Wood, Phillipsburgh, N. J.

Distribution.—*Mains*, 10 to 4-in. c. i., 5 miles; from Jackson & Woodin Mfg. Co., Berwick, Pa.; trenching and pipe-laying done by Chas. K. Moore, N. Y. City. *Hydrants*, Ludlow, 30. *Valves*, Ludlow.

Financial.—Cost, $40,000. Cap. stock, authorized and paid up, $60,000. Bonded debt, $40,000. Int., 6%. Hydrant rental, $33.

Management.—Prest., C. N. Hoagland. Secy., C. O. Gates. Treas., E. A. Lovell, 71 Liberty St., N. Y. City. Supt., Geo. Merritt. Date of report, Mar. 1, '90.

SAINT JOHNSVILLE, *Montgomery Co.* (Pop., 1,072; est., 1,200.) On plateau with Mohawk flats and river on south, and elevated land on north. Settled in '18; incorp. village in '37. No sewers or electric lights.

History.—Built in '79 by village for domestic supply.

Water Supply.—Springs in edge of village, by gravity.

Reservoirs.—Two; each 50 ft. sq., 8 ft. deep.

Distribution.—*Mains*, c. i., 3 miles. *Services*, w. i. *Taps*, 175. *Hydrants*, none.

Consumption, not given. *Pressure*, 80-ft. head.

Financial.—Cost, $5,000. Debt, $500. Int., 6%. Ann. op. exp., $100. Ann. rev.: consumers, $500.

Management.—Village Trustees. Prest., G. Hough. Supt., M. S. Schram.

SALAMANCA, *Cattaraugus Co.* (Pop., 2,531; est., 4,500.) On Allegheny river, on hilly ground. Has repair shops for 3 railroads; manufactures embroidery, leather and lumber. Incorp. Has sewers. No electric lights.

History.—Built in '81 by Salamanca Water-Works Co., under 5-years franchise. Des. Engr., J. O. McClure, Warsaw. Contrs., R. D. Wood & Co., Philadelphia, Pa., and Inman Bros., N. Y. City.

Water Supply.—Springs and surface water, generally by gravity, but in dry weather by pumping to reservoir.

Reservoirs.—Cap., 1,500,000 and 500,000 galls., respectively.

Pumping Machinery.—Dy. cap, 1,000,000 galls.; Gordon & Maxwell dup.

Distribution.—*Mains*, c. i., 5 miles. *Services*, mostly galv. i. *Taps*, 240. *Meters*, not given. *Hydrants*, Mathews, 43.

Consumption, 300,000 galls. *Pressure*, 75 lbs.

Financial.—Cost, $35,000. Debt, $20,000. Int., 6%. Ann. op. exp. (in '87), $300. Ann. rev.: consumers, withheld, est., $2,000; city, $1,300. Hydrant rental, $33.79.

Management.—Prest. Hudson Ansley. Secy., H. O. Wait. Treas., W. W. Millman. Supt., A. H. Krieger.

SANDY HILL, *Washington Co.* (Pop., 2,487; est., 3,000.) In Kingsbury township, on Hudson River. Engaged in manufacturing. Incorp. No sewers. Has electric lights.

History.—Built in '88 by Spring Brook Water Co., under unlimited franchise. Engr., Wm. B. Rider, South Norwalk, Conn. Contrs., Sherman & McDonough, now Troy Public Works Co.

Water Supply.—Brook, fed by springs, pumping to stand-pipe. Dy. cap. of brook, 750,000 galls.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; two Worthington comp., dup. *Boilers:* from Philo S. Curtis, Utica.

Stand-Pipe.—Cap., 223,360 galls.; 18x120 ft.; steel; gives a head of 161 ft.; from Porter Mfg. Co., Syracuse.

Distribution.—*Mains*, 12 to 4-in. c. i., 6¾ miles. Pipe and specials from McNeal Pipe & Foundry Co., Burlington, N. J. *Taps*, 149. *Services*, lead, w. i. *Meters*, 37. *Hydrants*, Mathews, 41. *Valves*, Eddy.

Consumption, 100,000 galls. *Pressure*, Ordinary, 50 lbs. Fire, 50 to 70 lbs.

Financial.—Cost, $80,000. Debt, $50,000: $10,000 at 6, $40,000 at 5%. Ann. op. exp., $1,500. Ann. rev.: consumers, $2,500; city, $2,562. Hydrant rental, $62.50; 5-years-contract.

Management.—Prest., Loren Allen. Treas. and Supt., O. A. Tefft.

SARATOGA SPRINGS, *Saratoga Co.* (Pop., 8,421; est., resident, 14,000, summer, 30,000.) Summer resort. Settled in 1773. Incorp. Has sewers and electric lights.

History.—Built in '71 by village. Des. Engr., H. F. Gaskill. Const. Engrs., Holly Mfg. Co., Lockport.

Water Supply.—Loughberry lake, by direct pumping. Lake has area of 96 acres, depth of about 20 ft., is 336 ft. above sea level, and fed by springs. Town is from 220 to 400 ft. above sea-level.

Pumping Machinery.—Dy. cap., 13,000,000 galls.; 2,000,000 Holly quadruplex, 5,000,000 and 8,000,000 Gaskill horizontal; latter added in '89.

Distribution.—*Mains*, c. i., 29 miles. *Services*, galv. i. *Taps*, 1,800. *Meters*, 14. *Hydrants*, Ludlow, Holly, Mathews, 212. *Pressure-recording gauge*, Edson.

Consumption, 3,000,000 galls. *Pressure:* Ordinary, 95 lbs. Fire, 130 lbs.

Financial.—Cost, $340,000. Debt, $317,000. Int., 4, 5 and 6%. Ann. op. exp., $12,000. Ann. rev.: consumers, $40,000.

Management.—Five Comrs. Prest., M. F. Muhan. Clerk, Saml. F. Corey.

NOTE.—For extended description of pumping engines and tests of same, see *Eng. News*, vol. X., p. 332, vol. XI., pp. 195–9.

SAUGERTIES, *Ulster Co.* (Pop., 3,923; est., 6,000.) On Hudson River at mouth of Esopus creek, 12 miles above Kingston. Has several manufactories. Incorp. No sewers or electric lights.

History.—Built in '87 by Saugerties Water Co., under 30-years franchise. Engrs., Arthur L. Betts and J. M. Low. Contr., J. M. Low, Kingston.

Water Supply.—Plotull creek, by gravity.

Distribution.—*Mains*, c. i., 13¼ miles. *Services*, rustless i. Pipe and specials from McNeal Pipe & Foundry Co., Burlington, N. J. *Taps*, 250. *Meters*, 3. *Hydrants*, Ludlow, 58. *Valves*, Ludlow.

Consumption, not determined. *Pressure*, 80 lbs.

Financial.—Cost, withheld, est., $175,000. Cap. stock, $100,000. Bonded debt, $100,000. Int., 6%. Ann. op. exp., withheld, est., $1,000. Ann. rev.: consumers, withheld, est., $7,000; city, $2,320. Hydrant rental, $40.

Management.—Prest., Matthew Trumpbower. Secy., Edwin B. Walker. Treas., Frank D. Bruyn. Supt., Philo Low.

SAYVILLE, *Suffolk Co.* See Islip.

SCHENECTADY, *Schenectady Co.* (Pop., 13,655; est., 20,000.) On Mohawk river. Engaged in manufacturing. Settled in 1684, created borough in 1765; incorp. city in 1798. Has sewers and electric lights.

History.—Built in '71; purchased by city in '85, from Schenectady Water Co.

Water Supply.—Mohawk river, by direct pumping.

Intake Crib and Pipe.—Crib is 13 ft. sq., of 12x12 timber bolted together to form 9 compartments, outer ones being filled with stone, and inner ones being 4 ft. square, with two water-ways also 4 ft. square. At mouth of each of latter there are ¾-in. iron rods, 1 in. apart, then two copper wire screens, ¼-in. mesh; besides these water must pass through two similar screens before entering suction pipe. Screens can be removed for cleaning.

Top of crib, and sides above low water, are covered with 3-in. oak plank. Piles are driven outside crib, bolted to it and filled between with stone. *Suction-pipe:* 20 ins. in diam., enters crib 5 ft. from bottom, and has 13 ball and socket joints to allow pipe to conform to surface of river bottom. New crib and suction-pipe were put in in '87. Engr., P. H. Baermann, Troy. Previously, water had passed through filter gallery near river.

Pumping Machinery.—Dy. cap., 10,000,000 galls.; 2,000,000 Deane, 3,000,000 and 5,000,000 Gaskill horizontal; first Gaskill built in '87, second in '89. A 2,000,000 Holly was formerly used. *Boilers:* Holly, 4.

Distribution.—*Mains*, w. i. and cem., 16½ miles. *Services*, w. i. *Taps*, 1,250. *Meters*, none. *Hydrants*, kind not given, 155. *Pressure-recording gauge*, Edson.

Consumption, 2,130,000 galls. *Pressure*, Ordinary, 85 lbs. Fire, 100 lbs.

Financial.—Cost, $131,766. Debt, $107,000: $90,000 at 4, $17,000 at 3%. Sinking fund, $2,370. Ann. op. exp., $14,328. Ann. rev.: consumers, $22,043; misc., $3,804.

Management.—Three Comrs. Prest., E. M. Jenkins Secy., E. C. Angle. Supt., Geo. T. Ingersoll.

SCHENEVUS, *Otsego Co.* (Pop., 900.) Incorp. village in '73. No sewers or electric lights.

History.—Built in '88 by Schenevus Village Water-Works Co. Engr., J. Walker. Labor done by Co.

Water Supply.—Springs, forming small stream, by gravity from reservoir. Drainage area, 5 sq m.

Dam and Reservoir.—Cap., not given. Flow-line, 300 ft. above village. Dam of masonry in cem., 55 ft. long and 10 ft. high; founded on bed rock.

Filter.—Gravel, 10 ft. deep.

Distribution.—*Mains*, 6-in. c. i., 3 miles, from R. D. Wood Co., Philadelphia, Pa. *Taps*, 25. *Hydrants*, Galvin, 13. *Valves*, Eddy.

Consumption, 600,000 galls.; 100,000 by R. R. *Pressure*, 130 lbs.

Financial.—Cost, $20,000. Cap. stock, [$7,500. Bonded debt, $13,000. Int., 6%. Ann. op. exp., $100. Ann. rev.: consumers, $900; $800 from R. R. Co.; city, $325. Hydrant rental, $25.

Management.—Prest., Byron Cass. Secy. and Treas., Lottie A. Field, Cooperstown. Supt., P. J. Lewis.

SEA CLIFF, *Queens Co.* (Pop., est., 1,000.)

History.—Built for domestic supply in '72 by Sea Cliff Grove & Metropolitan Camp Ground Assn. of N. Y. and Brooklyn. Labor done by Co.

Water Supply.—Seven driven wells, pumping to tank.

Pumping Machinery.—Dy. cap., not given; Worthington and Blake.

Tank.—Cap., 28,000 galls.; 18 x 15 ft.

Distribution.—(In '87.) *Mains*, c. i., 5 miles. *Services*, lead. Pipe and specials from Jno. Simmons. *Meters* and *Hydrants*, none.

Consumption and *Pressure*, not given.

Financial.—(In '87.) Cost, $5,000. Ann. op. exp., $1,200. Ann. rev.: consumers, about $1,500.

Management.—Prest., J. T. Pirie. Secy., J. K. Myers.

SENECA FALLS, *Seneca Co.* (Pop., 5,880; est., $8,000.) On Seneca river, having good water-power used in manufacturing knit goods, hand and steam pumps and fire engines. Incorp. Has sewers and electric lights.

History.—Built in '87 by private Co. Engr., G. Norman Weaver, Newport, R. I. Contrs., New England Construction Co., Newport, R. I. Sub-contr. for masonry and buildings, G. W. Bartowe, Seneca Falls.

Water Supply.—Cayuga lake, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; comp. vertical piston pump, made by A. Russell & Son, Newburyport, Mass.

Stand-Pipe.—Cap., 423,000 galls.; 30 x 80 ft.; from R. F. Hawkins, Springfield, Mass.

Distribution.—*Mains*, w. i. and cem., 12 miles. *Services*, w. i. and cem. *Taps*, 400. *Meters*, not given. *Hydrants*, Chapman, number not given. *Valves*, Chapman.

Consumption, 150,000 galls. *Pressure:* Ordinary, 50 lbs. Fire, 100 lbs.

Financial.—All data withheld. *Estimates:* Cost, $150,000. Ann. op. exp., $2,500. Ann. rev., $15,000.

Management.—Prest., C. S. Hood. Secy., Frank Wescott. Treas., G. N. Weaver, Newport, R. I. Supt., A. C. Martin.

SHEEPSHEAD BAY, *Kings Co.*

SHELTER ISLAND, *Suffolk Co.* (Pop., town, 732.) On island between Little Peconic and Gardiner's Bay, Long Island Sound.

General Description.—Small works built in '89 to supply few cottagers. Have 300,000-gall. Worthington pump. Address Wesley Smith.

SHERBURNE, *Chenango Co.* (Pop., 944; est., 1,000.) On Mad brook, tributary of Chenango river. Incorp. No sewers or electric lights.

History.—Built in '83 by village. Also supplies small village called Sherburne Quarter. Des. Engr., W. S. Franklin, Johnstown. Const. Engr., A. J. Read.

Water Supply.—Surface water, by gravity from impounding reservoir. Drainage area, about 5 sq. m.

Dam and Reservoir.—Cap., 10,460,000 galls.; area, 3 acres; greatest depth, 20 ft.; 1¾ miles from, and 240 ft. above, village. Dam of earth with heart-wall; 357 ft. long, about 24 ft. high; slopes about 2 to 1, inner riprapped. Foundation, rock for 205 ft. from one end, including highest portion; coarse gravel remainder of distance. *Heart-wall:* puddle, carried below natural surface; stops 24 ft. from one end, and in part without heart-wall there is some leakage. *Spillway:* in dam, near end, in rock, lined with masonry, free; 40 ft. wide; slope, nearly level. Has masonry wing-walls. *Discharge-pipe:* 20-in.; two cut-off walls, one each side heart-wall. Dam does not leak badly. Engr., W. S. Franklin. Contr., D. S. Read. Cost, $33,000.

Stand-Pipe.—Diam., 12 ins.; height, not given; on supply main, near dam, inclosed in masonry tower.

Supply Main.—Diam., 10 ins.; length, about 1¾ miles.

Distribution.—*Mains*, c. i., 4¾ miles. *Services*, black i. *Taps*, 150. *Meters*, none. *Hydrants*, Bailey, 21. *Valves*, Eddy.

Consumption, 40,000 galls. *Pressure*, 100 lbs.

Financial.—Cost, $37,000. Debt, $31,000. Int., 4%. Ann. op. exp., $500. Ann. rev.: consumers, $1,900.

Management.—Three Comrs. Secy. Cortland Wilber. Treas., Jesse H. Shephard. Supt., W. E. Davis.

SHERBURNE QUARTER, *Chenango Co.* (Pop., est., 500.) In town and near village of Sherburne, with P. O. there. See Sherburne.

SIDNEY, *Delaware Co.* (Pop., est., 1,500.) On Susquehanna river, in farming section. Incorp. village. No sewers or electric lights.

History.—Built in latter part '89 by Sidney Water-Works Co. Engr., Wm. B. Rider, So. Norwalk, Conn. Supt. construction, R. B. Carter. Labor done by Co.

Water Supply.—Mountain stream, filtered, by gravity from impounding and distributing reservoirs. Water flows between reservoirs in natural bed of stream

Reservoirs.—Cap., about 10,000,000 galls. About 1,000 ft. apart, nearly two miles from village.

Filter.—At distributing reservoir; sand.

Supply Main.—Diam., 10 ins. at first, then 8.

Distribution.—*Mains*, including supply, 10 to 4-in. c. i., 5 miles. Pipe from Warren Foundry & Machine Co., Phillipsburgh, N. J.; globe specials from Builders' Iron Foundry, Providence, R. I. *Hydrants*, Ludlow, 26. *Valves*, Ludlow, Eddy.

Pressure, 95 lbs.

Financial.—Cost., $35,000. Cap. stock, $30,000. Bonded debt, $15,000. Int., 4%.

Management.—Prest., Henry W. Clark. Secy. and Supt., Wm. E. Barker. Treas., John A. Clark. Date of latest report, Dec. 5, '89.

SILVER SPRINGS, *Wyoming Co.* See Castile.

SING SING, *Westchester Co.* (Pop., 6,578.; est., 7,000.) In Ossining township on Hudson river. Has various manufactories. Incorp. Partially sewered. Has electric lights.

History.—Built in '88-9 by village. Engr., Chas. W. Knight, Rome.

Water Supply.—Indian brook, pumping from impounding to distributing and high-service reservoirs.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; comp., cond.; from National Iron Works, New Brunswick, N. J.

Reservoirs.—*Impounding:* on brook at elevation of 188 ft., Croton datum, and Indian brook distributing reservoir, elevation 326.5 ft.; Contrs., Ward & Leary, Jersey City, N. J. *High-service:* elevation, over 400 ft.; Contrs., Genung, Rider & Co., Sing Sing.

Distribution.—Added to considerably since Jan. 1, '89.) *Mains*, c. i., 6 miles; from Gloucester Iron Works, Philadelphia; laid by Scribner & Fogg, N. Y. City. *Taps*, not determined. *Hydrants*, Mathews, 93. *Valves*, Eddy.

Financial.—Cost, about $150,000. Bonded debt, $150,000. Int., 4%. Other data not determined.

Management.—Comrs. Prest., J. P. Truesdell. Secy., S. M. Sherwood. Treas Isaac B. Noxon. Supt., Seth G. Ellegood.

SPRINGVILLE, *Erie Co.* (Pop., 1,227; est., 2,000.) On Spring creek. Manufacturing town in dairying district.

History.—Built in '88 by Springville Water-Works Co. Engrs. and Contrs., Michigan Pipe Co, Bay City, Mich.

Water Supply.—Springs, direct pumping from collecting reservoir.

Reservoir.—Cap., 375,000 galls.; 50 x 100 ft., x 10 ft. deep.

Pumping Machinery.—Dy. cap., 750,000 galls.; Gaskill water-power. *Waterwheel:* Leffel turbine.

Distribution.—*Mains*, wood, 2 miles. *Services*, lead. *Taps*, not given. *Meters*, none. *Hydrants*, kind not given, 19.

Consumption, not given. *Pressure:* Ordinary, 35 to 40 lbs. Fire, 80 lbs.

Financial.—Cost, withheld, est., $30,000. Cap. stock, $100,000. Other data not determined, or withheld.

Management.—(In '88.)Prest., Mrs. E. Corbet. Secy., L. J. Shuttleworth. Treas., C. B. Shuttleworth.

STAMFORD, *Delaware Co.* (Pop., 761; est., 1,300.) On Delaware river, in mountainous district 1,800 ft. above sea-level. Settled in 1790: incorp. village in '70. No sewers or electric lights.

History.—Built in '83 by Stamford Water-Works Co., under 99-years franchise. Engr., W. B. Rider, So. Norwalk, Conn.

Water Supply.—Head-water of Delaware river, one mile from its source, by gravity from impounding reservoir. Drainage area, 3 sq. m.

Dam and Reservoir.—Cap., not given. Dam of masonry in cem., 12 ft high, 75 ft. long, with flow-line about 150 ft. above the village.

Filter.—Wire screen, sponge and charcoal.

Distribution.—*Mains*, c. i., 2½ miles. *Services*, lead. *Taps*, 75. *Meters*, none. *Hydrants*, Mathews, 19. *Valves*, Ludlow.

Consumption, not given. *Pressure*, 60 lbs.

Financial.—Cost, $24,000. Debt, $4,000. Int., 6%. Ann. op. exp., $50. Ann. rev.: consumers, $1,200; city, $200. Hydrant rental, $20.

Management.—Prest., V. Z. Wyckoff. Treas., J. H. Merchant. Supt., Johnson Hamilton.

STAPLETON and EDGEWATER, *Richmond Co.* (Pop.: Stapleton, est., 2,500. Edgewater, 8,044.) On Staten Island, about 6 miles from N. Y. City.

History.—Built in '84 by Crystal Springs Water Co. Original Chf. Engr., C. Delafield, N. Y. City. Contrs., Bond & Dietrick.

Water Supply.—Driven wells, direct pumping. First supply, stream at Bullshead.

Pumping Machinery.—(In '84.) Dy. cap., 2,000,000 galls.; two 1,000,000 Worthington.

Distribution.—(In '84.) *Mains*, spiral welded i., 13 miles; afterwards replaced by c. i. *Hydrants*, 125.

Financial.—No data, save that that the cost is high and that there have been at least 3 issues of bonds.

Management.—Treas., Chas. D. Bond. Supt., Calvin Dietrick, 52 Broadway, N. Y. City.

SUSPENSION BRIDGE, *Niagara Co.* (Pop., 2,476; est., 3,000.) On Niagara river, two miles from Niagara Falls village. Incorp. village. No sewers. Brush electric lights.

History.—Built in '75 by village. Supplies water to village of Niagara Falls, under 10-years' contract from '84. Des. Engrs. and Contrs., Holly Mfg. Co., Lockport. Constr. Engr., C. F. Shelley, Lockport. Sub-contr. for masonry, Jacob Wagner.

Water Supply.—Niagara river, by direct pumping.

Intake.—Not described.

Pumping Machinery.—Dy. cap., 6,000,000 galls.; 1,500,000 Holly quadruplex. 5,000,000 Gaskill water-power. *Water-wheel:* turbine.

Distribution.—*Mains*, iron, 6½ miles. *Services*, iron. Pipe and specials from Drullard & Hayes, Buffalo. *Taps*, not given, est., 350. *Meters*, none. *Hydrants*, Holly, 53. *Valves*, Holly.

Consumption, 3 600,000 galls., including supply to Suspension Bridge. *Pressure:* Ordinary, 60 lbs. Fire, 125 lbs.

Financial.—Cost (Feb. 1, '90), $160,000. Bonded debt (Feb. 1, '90), $125,000. Int., 4, 5, 6 and 7%. Sinking fund, none. Ann. op. exp., $6,500. Ann. rev.: consumers, $7,500, Suspension Bridge; also 40% of Niagara Falls Water-Works Co.'s gross rev., or about $4,000.

Management.—Comrs. Prest., Jacob Bingenheimer. Secy., Thos. Hannan. Supt., Henry A. Keller.

SYRACUSE, *Onondaga Co.* (Pop., 51,792; est., 83,000.) On Onondaga lake, on gently undulating ground. Has large business and manufacturing industries, large part of salt industry of continent centering here. Settled in 1796; incorp. village in '25; city in '47. Has sewers and electric lights.

History.—First supplied in '29 by Oliver Tease, Aaron Borst and Ira Seymour, from springs, by gravity. In '49 Syracuse Water Co. was organized and owns present works.

Water Supply.—Springs and surface water, by gravity, and pumping to reservoir. Raynor and Talf springs supply first reservoir constructed, which is 107 ft. above Erie canal in city, and from here their water goes to main reservoir. In '71 water was pumped to reservoir from Onondaga creek. Later, water from Furnace brook was stored in a 176,000,000-gall. reservoir on Onondaga hill, 450 ft. above canal, and distributed from a 6,500,000-gall. reservoir 161 ft. above canal. This reservoir is not mentioned in report for '88.

Pumping Machinery.—Dy. cap., 16,000,000 galls.; one 10,000,0 0 Worthington and two 3,000,000 Deane.

Reservoir.—Cap., 80,000,000 galls.

Distribution.—*Mains*, c. i., w. i. and cem., 42 miles. *Services*, lead. *Taps*, 2,890. *Meters*, 430. *Hydrants*, kind not given, 385.

Consumption, 6,000,000 galls. *Pressure*, 40 lbs.

Financial.—Cost, $860,000. Cap. stock, $440,000. Bonded debt, $200,600: $38,100 at 7, $162,500 at 6%. Ann. op. exp., withheld, est., $25,000. Ann. rev.: consumers, withheld, est., $60,000; city, $26,000 for all purposes.

Management.—Prest. and Mgr., D. H. Bruce. Secy. and Treas., J S. Butler.

NOTE —There has been much agitation concerning new supply. Several propositions were made by Cos. and individuals in '88-9, and Legislature granted city the right to issue $3,000,000 of bonds to purchase Co.'s works, and to obtain a supply from Skaneatelas lake, 17 miles distant. Objections having been made to drawing water from proposed source, on ground that it would diminish supply to Erie Canal, public hearings on the subject were held in summer and fall of '89.

For further information regarding the supply recommended and investigatlons made, see:

"Report of Commissioners on Sources of Water Supply for the city of Syracuse, N. Y.," Feb. 1, '89. This includes the Report of J J. R. Croes, N. Y. City, Engr. to the Commission.

Also supplementary reports by Mr. Croes, dated Aug. 29, and Nov. 11, '89.

Also report to Water Board by Howard Soule, dated Aug. 28, '88.

The above favor Skaneateles lake as a source of supply. In opposition see "Engineer's Report on the taking of Skaneateles lake by the city of Syracuse for a water supply," by Stephen E. Babcock, Little Falls. Dated Sept. 23, '89.

TARRYTOWN, *Westchester Co.* (Pop., 3,025; est., 6,500.) On Hudson river, on ground rising abruptly 300 ft. Has manufactorics. Has electric lights.

History.—Built in '87 by village; new works built in '89. Engr. of latter, Saml. B. Leach. In '77 a fire-protection plant was put in with Chas. E Fowler as Engr. For description of old works see MANUAL for '89.

Water Supply.—Surface well, pumping to reservoir and tank; latter for high service. Well is 15 ft. in diam., 35 ft. deep, lined with 30-in. wall of masonry in cement, carried 2½ ft. above surface; sunk by means of hydraulic jet. Well in swamp at East View, about one mile from village limits. Dy. yield, 500,000 galls. Contr., C. L. Kalmbach, Tarrytown. Another, larger, well will probably be sunk in '90. Drainage area, 1¼ sq. m *Suction-pipe:* diam., 12 ins.; length, 150 ft.

Pumping Machinery.—Dy. cap., 1,250,000 galls.; Worthington comp., cond., high or low-pressure. *Boilers:* two 40 H. P. horizontal, tubular, 12x4 ft.; from B. W. Payne's Sons, Elmira.

Force Mains.—*Low Service:* diam., 10 ins.; length, 2:500 ft.; rise, 85 ft. *High Service:* diam., 6 ins.; length, 4,500 ft.; rise, 200 ft.

Reservoir.—Cap., 1,250,000 galls.; 120x170 ft.,x15 ft. deep; elevation, 325 ft. above Hudson river; in excavation and embankment, with banks about 18 ft. high, 10 ft. wide on top. Both slopes, 1½ to 1; inner covered with 1 ft. of riprap; outer grassed. Top covered with 6 ins. of gravel. *Heart-wall:* masonry, 4½ ft. thick at bottom, 2 at top; filled against inner side of bottom with 2 ft. clay puddle. Contr., —— Merritt, Port Chester.

Tank.—Cap., about 150,000 galls.; iron, 30 ft. in diam., 30 ft. high. Elevation, 450 ft. above Hudson river. Contrs., Moore & Shaler. N. Y. City.

Supply Mains.—Diam., 6 and 4 ins.

Distribution.—*Mains,* 6 and 4-in., iron, about 6 miles. No further data.

Consumption, not determined. *Pressure,* 138 lbs.

Financial.—Cost, about $75,000. Bonded debt, $60,000, or more. Int., not given. Other data, not determined.

Management.—Six Comrs. Prest., D. D. Tallman. Secy., F. R. Pierson. Treas., Eugene Barnes.

THOUSAND ISLAND PARK, *Jefferson Co.* (Pop., not given.) On Wells' Island in St. Lawrence river. Summer resort.

NOTE.—Water is pumped from St. Lawrence river to reservoir. No further data can be obtained.

TICONDEROGA, *Essex Co.* (Pop., est., 2,000.) On outlet of Lake George, Manufactures iron, lead, lumber, cotton and woolen goods. No sewers. Has electric lights.

History.—Built in '75 by Ticonderoga Water-Works Co. Engr., D. M. Arnold.

Water Supply.—Lake George, by gravity.

Distribution.—*Mains,* c. i., 2½ miles. *Services,* galv. i. *Taps,* 175. *Meters,* none. *Hydrants,* from N. A. Buck & Co., Philadelphia, 7 public and 2 private. *Valves,* Ludlow.

Consumption, about 20,000 galls. *Pressure,* 80 lbs.

Financial.—Cost, 20,000. Cap. stock, $20,000. No debt. Ann. op. exp., $1,900. Ann. rev:: consumers, $3,300; city, $75. Hydrant rental paid by individual subscriptions.

Management.—Prest., J. B. Ramsey. Secy. and Supt., C. E. Bennett. Treas., C. E. Bush.

TONAWANDA and NORTH TONAWANDA, *Erie Co.* (Pop., 3,864; est., 5,000.) On Niagara river, at outlet of Tonawanda creek. Manufactures lumber, and is one of largest lumber centers in United States. Incorp. No sewers or electric lights.

History.—Built in '87 by Tonawanda City Water-Works Co. Des. Engr., Geo. P. Smith. Const. Engr. B F. Betts, both of Tonawanda.

Water Supply.—Niagara river, by direct pumping.

Pumping Machinery.—Dy. cap., 4,000,000 galls.; Holly-Gaskill.

Distribution.—*Mains*, 16¼ miles; Wyckoff wood, from Michigan Pipe Co., Bay City; laid by Co. *Services*, not given. *Taps*, 496. *Meters*, none. *Hydrants*, Gaskill, 204. *Valves*, Galvin.

Consumption, 1,000,000 galls. *Pressure :* Ordinary, 40 lbs. Fire, 80 to 150 lbs.

Financial.—Cost, $130,000. Cap. stock, $60,000. Bonded debt, $120,000. Int., 6%. Ann. op. exp. $5,000. Ann. rev.: consumers, $5,000; cities, $9,040. Hydrant rental, $40 each.

Management.—Prest., B. L. Rand. Secy. and Treas., Geo. P. Smith. Supt., Henry M. Fales.

TROY, *Rensselaer Co.* (Pop., 56,747; est., 60,000.) On Hudson river, opposite mouth of Mohawk and at head of steam navigation. Along river land is level, then rises abruptly 150 ft. above tide. Manufactures iron, steel, stoves, collars and cuffs, and has large river trade. Incorp. Has sewers and electric lights.

History.—Built in '33 and rebuilt in '80, by city. Engr. of new works, David M. Greene. In '29, pop. being 10,000, a Water Co. was chartered, but taking no action its charter was purchased in '33 by town for $173.34, and works built.

Water Supply.—Five artificial storage reservoirs in valley of Piscawen Kill, by gravity, and Hudson river, at Lansingburg, 3 miles above Troy, pumping to Oakdale reservoir on above creek. Piscawen creek has drainage area of 1,363 acres.

Old Dams and Reservoirs.—First dam of logs and stone forming impounding reservoir, from which water was passed through settling and intermediate basin to reservoir covered with brick arch and paved with brick in cem. In '56 old dam was replaced by one of stone, two 20-in. pipes leading from it to reservoir, one near bottom, and one 3 ft. above, and a 20-in. main leading to city. Distributing reservoir was 304 x 18.3 ft., x 8.3 ft. deep; 110 ft. above river, 62 ft. above and 1,800 ft. from main street of town. In '67 this reservoir leaked so badly that a strong puddle was substituted in place of stone wall on west side.

Piscawen Creek Dams and Storage Reservoirs.—Combined cap., not given. Numbers below are in order of construction.

No. 1: cap. not given. Near Oakwood ave., dam of earth, with heart-wall; 270 ft. long on top, 40 ft. high. *Heart-wall:* puddle. *Spillway:* in rock, south of dam. *Discharge-pipes and culvert:* at first, two 12 and one 20-in. pipes were laid through and beneath dam in rock trench, and surrounded with puddle; in '70 a brick culvert was built through dam and pipes placed in it. Built in '59.

No. 2: cap., 250,000,000 galls.; area, 34 acres. Near Cemetery Ave. Formed of clay, sand and earth puddle, latter being 20 ft. wide at bottom and 16 on top. Bank is 43 ft. high. Embankment of Cemetery Ave. formed back filling, and effluent-pipe was laid through it in brick culvert, at upper end of which was brick well, 18 x 20 ft., coped with stone, and having dividing wall. Walls were 4 ft. thick at bottom, 2½ at top, and in the well were 4 gates at different levels. Built in '62.

No. 3: Cap., 180,000,000 galls.; depth, 20 ft.; 4 miles from city, similar to others in construction. Dam 30 ft. high. Culvert for effluent pipe oval, 6½ ft. in diam., 125 ft. long.

Other reservoirs not described.

Inlet Piers.—Stone masonry, 356 ft. from pump-well, 250 ft. from original Hudson river shore line, in 6¼ ft. of water at low stage. Founded on rock, 55 ft. long, 20½ ft. wide, bottom carried up 26½ ft., or 5 ft. above highest known freshet level; has brick gate-house on top. Well in center 6 ft. sq., has two influent openings, 3 ft. sq. one midway between bottom and low water, other midway between bottom and high water. Flow regulated by gates, or screens, placed in pockets in side of well, operated by hand wheels in gate-house. Wall is carried down 15 ft. in rock, where it meets tunnel to well. In view of possible destruction to State dam a 30-in. pipe is laid out to old channel of river.

Tunnel.—From inlet pier to pump-well, 356 ft.; in solid rock, 7½ ft. wide, 4½ ft. high, with ascending grade 1 ft. in 140.

Pump-well.—Under engine-house, 8 x 12 ft., x 45 ft. below surface of ground, or 38 ft. below cellar bottom. Walls of solid rock-dressed masonry, 2 ft. thick, with coping 14 ft. below low water in river.

Pumping Machinery.—Dy. cap., 7,000,000 galls.; two sets of quadruplex engines driving Holly pumps; steam cylinders are 27 x 36 ins.; pumps, 17¾ x 36 ins.

Force Main.—Starts from engine house in two 18-in. branches, which unite outside in a 30-in. main, 16,000 ft. long, terminating in a masonry wall at Oakwood Avenue reservoir. Main has several curves of 10 ft. radius.

High Service Reservoir.—Cap., 2,500,000 galls.; built on Piscawen creek, in connection with new supply. Triangular, with flow line 382 ft. above tide-level, with main dam, compartment and head walls. *Main dam:* earth, 380 ft. long, 19 ft. high and 4 ft. above high water; 15 ft. wide on top; inner slope, 2 to 1, outer, 1½ to 1; puddle wall 6 ft. wide on top, increasing in width 1 ft. for each 6 in depth, carried into rock bed. There is a waste-weir and a 20-ft. masonry spillway. *Compartment wall:* 120 ft. above main dam, rubble masonry in cem., 110 ft. long, with spillway 57 ft. long. *Head wall:* 270 ft. above main dam, 60 ft. from head of pond, of masonry, 33 ft. long on top, with 27-ft. spillway. Gates in well and gate-house are so managed that water can be drawn only from upper 6 ft. of reservoir, though total depth of water is 15 ft.

Supply Main.—From high service reservoir to city; 20-in.

Distribution.—(Feb. 28, '89.) *Mains*, c. i., 53 miles. *Services*, c. i., lead. *Taps*, 5,500. *Meters*, 100. *Hydrants*, Bailey, Ludlow, 645. *Pressure-recording gauge*, Edson. *Close of* '56: Mains, 17¼ miles. Hydrants, 55. *Do.*, '70: Mains, 22½ miles. Hydrants, 141. *Do.*, '80: Mains, 41¾ miles. Meters, 5. Hydrants, 383.

Consumption, 8,000,000 galls. *Pressure*, 60 lbs.

Financial.—(Feb. 28, '89.) Cost, $1,172,000. Debt, $416,000. Int., 4%. Sinking fund, $37,663. Ann. op. exp., $58,676. Ann. rev.: consumers, $91,503. Cost in '56, $215,992; do., '70, $346,561; do., '80, $839.570. Rev., '56, $23,771; do., '70, $26,900; do., '80, $58,104.

Management.—Five Comrs. Clerk, Geo. B. Fales. Chf. Engr. and Supt., Edw. Dolan.

Reference.—Tenth Census U. S., vol. XVII., Water Supply of American Cities, pp. 160–3.

UNADILLA, *Otsego Co.* (Pop., 922; est., 1,500.) On Susquehanna river. Has some manufactories. Settled before revolutionary war, organized in 1792, incorp. village in '27. Has sewers and electric lights.

History.—Built in '86 by S. S. North. Consult. Engr., Peter Hogan. In '80 Mr. North built works for fire protection.

Water Supply.—Springs, by gravity from collecting reservoirs and by pumping to reservoir.

Pumping Machinery.—Dy. cap., 86,400 galls.; make not given.

Reservoirs.—Cap., 2,000,000 galls. First was 100 x 56 ft., x 7 ft. deep, in embankment, with puddle walls, 150 ft. above main street of village.

Filter.—Of sponge, at reservoir.

Distribution.—*Mains*, c. i., 2 miles. One mile of asphalted w. i. pipe was laid, but proving unsatisfactory was replaced by c. i. *Services*, w. i., lead. *Taps*, 100. *Meters*, National, 1. *Hydrants*, Mathews, 16. *Valves*, Eddy.

Consumption, 100,000 galls. *Pressure*, 65 lbs.

Financial.—Cost, withheld, est., $15,000. No debt. Ann op. exp., $50. Ann. rev.: consumers, withheld, est., $1,500; city, $800. Hydrant rental, $50.

Management.—Owner, S. S. North. Supt., D. H. Loomis.

UNIONVILLE, *Kings Co.* See Gravesend.

UTICA, *Oneida Co.* (Pop., 33,914; est., 45,000.) On Mohawk river. Manufactures iron, shoes, clothing, cotton and woolen goods. Founded in 1757; incorp. village in 1798, a city in '52. Has electric lights.

History.—Present works built in '49 by Utica Water-Works Co. Engr. and Contr., Thos. Hopper.

From '02 to '24 part of village was supplied with water for domestic use by Utica Aqueduct Co.; cap. stock, $5,000; supply, springs, through wooden logs.

From '05 to '22 village was protected from fire by three wells, fitted with pumps, work being done by village trustees.

From '24 to '34 the only water was from private wells. In '26 "Utica Aqueduct Company in the Co. of Oncida" was incorporated, but did no work. In '32 Utica Water-Works Association was formed, and from '34 to '50 furnished spring water by gravity. In '45 Legislature authorized Edward Broadhead to supply Utica with water. He made plans and surveys for a supply through a 6-in. log aqueduct from Starch Factory creek, but receiving little encouragement abandoned the project. Present Co. was incorp. in '48.

Water Supply.—Surface water, by gravity from impounding to distributing reservoir.

Reservoirs and Conduits.—Cap., about 800,000,000 galls., there being three storage and one distributing reservoirs. First storage reservoir took drainage from about 16 acres of broken land, having slate substratum; area, 10 acres; depth 30 ft.; a distributing reservoir was used in connection with it, but it has been abandoned. Water from first reservoir flows in stream about 2½ miles, passing over Buttermilk falls, of 60 ft., flowing underground 360 ft., and entering second reservoir, built in '54, with banks 50 ft. high, cap. of about 40,000,000 galls., and covering 7 acres. In '68 distributing reservoir was built one mile from, and 260 ft. below second storage reservoir, covering 11 acres, having depth of 22 ft., cap of 40,000,000 galls., and being 80 ft. above highest point in city. At this time aqueduct cap. to city was increased from one 10-in. to two 12-in. conduits. In '73-4 storage reservoir of about 300,000,000 galls. cap., and 30 acres area, was constructed. Its banks are 360 ft. wide at bottom, 20 at top, and 70 ft. high Connection is made with the distributing reservoir by 20-in. pipe, reduced to 12 ins. In '85-6 fourth storage reservoir was built; cap., with banks 47 ft. high, about 400,000,000 galls. When necessary banks will be raised an additional 20 ft.

Distribution.—(In '87.) *Mains*, c. i., 50 miles. *Services*, lead *Taps*, about 2,600. *Meters*, about 1,500. *Hydrants*, Mathews, Galvin, Ludlow, Bigelow, about 325. *Valves*, kind, do.

Consumption, (in '87) 3,000,000 galls. *Pressure:* Ordinary, 30 lbs. Fire, 130 lbs.

Financial.—(In '87.) Cost, withheld, est., $790,000. Cap. stock, $500,000. Bonded debt (in '86), $150,000. Int., 4, 5 and 7%. Under contract made in '68, city pays $10,000 yearly for all purposes, ½ of all taxes above $1,000 on Co.'s property within city limits, 7% annually upon cost of all extensions beyond a certain limit, and furnishes hydrants.

Management.—Prest., Thomas Hopper. V. Prest., A. G. Brower. Secy., J. K. Chamberlayne. Treas., Publius V. Rogers. Supt., W. Pratt.

Reference.—Historical and descriptive sketch of these works was read before the Oneida Historical Society in '86, by the "President, Projector and Builder" of the works, Thos. Hopper, and has been printed in pamphlet form, 20 pp.

WALTON, *Delaware Co.* (Pop., 1,389; est., 2,300.) On Delaware river, in valley about one mile wide, surrounded by steep hills from 400 to 800 ft. high. Settled in 1784; incorp. in '51. No sewers. Electric lights built in '89

History.—Built in '79 by Walton Water Co. Engr., Wm. B. Rider, So. Norwalk, Conn. Contrs., Sherman & McDonough, now Troy Public Works Co.

Water Supply.—Surface water, by gravity from impounding reservoir on stream draining 8 sq. m.

Dam and Reservoir.—Cap., not given; area, 2¼ acres; 205 ft. above village. Dam of earth with heart-wall; 210 ft. long, 18 to 22 ft. high; inner slope 2 to 1, outer, 1½ to 1. *Heart-wall:* dry rubble, 12 ft. thick at bottom, 5 ft. at top, backed with a 3-ft. wall in cement. *Spillway:* lower face 60 ft. long, laid up in steps of 1 to 1.

Filter.—In dam, 4 x 10 ft., x 18 ft. deep, chamber being in 3 compartments, separated by wire screens. In first compartment there is 6 ft. of charcoal, in second, 18 ins. of sponge, and from third water flows to village. Filter will pass 30,000 galls. a day.

Supply Main.—Consists of 165 ft. of 10, and 8,814 ft. of 8-in. c. i.

Distribution.—*Mains*, c. i., 6 miles. *Services*, enam. i., galv. i., lead. *Taps*, 185. *Meters*, not given. *Hydrants*, Mathews, 43.

Consumption, not given. *Pressure*, 85 lbs.

Financial.—Cost, $25,000. Cap. stock, $25,000. No debt. Ann. op. exp., $50. Ann. rev.: consumers, $2,000; city, not given.

Management.—Prest., Strong Comstock, Secy., G. W. Fitch. Treas., Geo. O. Mead. Supt., J. W. St. John.

WARRENSBURGH, *Warren Co.* (Pop., 748.) On Schroon river. Manufactures leather, pulp and lumber. Not incorp. No sewers or electric lights.

History.—Built in '84 by Warrensburgh Water Co.

Water Supply.—Brook, fed by springs, by gravity.

Reservoir.—No data.

Distribution.—*Mains*, c. i., 6 miles. *Services*, galv. i. *Taps*, 79. *Meters*, none. *Hydrants*, kind not given, 7.

Consumption, not given. *Pressure*, 110 lbs.

Financial.—Cost, $5,000. Debt, $4,000. Int., 6%. Ann. op. exp., nominal. Ann. rev.: consumers, $800; city, none.

Management.—By Saml. Bates and Supt. Ira Cole.

WARSAW, *Wyoming Co.* (Pop., 1,910; est., 3,000.) On Allen creek, between two ranges of hills, 1,013 ft. above sea-level. Works salt deposits near by. Settled in '03; incorp. village in '47. Has sewers. No electric lights.

History.—Built in '70 by Warsaw Water-Works Co. Engr., Jas. O. McClure.

Water Supply.—Springs, by gravity from collecting reservoirs.

New Collecting Main.—Laid in '89; 2,400 ft. of 12, 1,600 ft. of 10, 800 ft. of 8-in.

Reservoirs.—Combined cap., est., 4,500,000 galls.; one 60 ft. sq., 25 ft. deep; one 250 ft. sq., 14 ft. deep.

Distribution.—*Mains*, c. i. (in '87), 10 miles. *Services*, w. i. *Taps* (in '87), 300. *Meters*, 5. *Hydrants*, Ludlow, about 60. *Valves*, Ludlow.

Consumption, unknown. *Pressure*, 128 lbs.

Financial.—Cost (in '86), $40,000. Cap. stock, $25,000. Debt, $4,000 Int., 6%. Ann. op. exp., withheld, est., $900. Ann. rev.: consumers (in '87), $3,700; city, none.

Management.—Prest., Secy. and Treas., E. H. Morris.

WARWICK, *Orange Co.* (Pop., 1,043; est., 1,300.) On Mistucken creek, in hilly and rocky country. Settled in 1719; incorp. in '67.

History.—Built in '72 by village. Engr., Chas. Caldwell. Contrs., Am. W. Wks. & Gas Pipe Co., now Ferris & Halladay, Jersey City, N. J.

Water Supply.—Surface water, by gravity from impounding reservoir on small stream.

Dam and Reservoir.—Cap., 8,300,000 galls.; area, 341 acres; about one mile from and 150 ft. above village. Dam of earth with heart-wall; 200 ft. long, some 70 ft. being built into banks at east side; 28 ft. high, water 6 ft. below top; 12 ft. wide on top. Inner slope, not given, covered with riprap; outer, 1½ to 1, with retaining wall 4 ft. high at foot. *Heart-wall:* puddle, 10 ft. thick at bottom, 5 at top. *Spill-way:* 26 ft. long, 2 ft. deep in body of dam; at and in end of dam, in rock, lined with masonry, free; water discharges into brook about 110 ft. below dam. *Discharge-pipes:* 12-in. supply-main, with 16-in. blow-off; 12-in. waste-pipe.

In Sept., '88, heavy rain caused washout in lower slope, 26 ft. from apron, 60 ft. wide, from 2 to 7 ft. deep from top to retaining wall. Cost of repairs, $122.

Ever since construction dam has leaked slightly near 16-in. blow-off gate, but leak does not increase. Date built, Engr. and Contrs., see History. Cost, $1,819.

Distribution.—*Mains*, 16 to 4-in. w. i. and cem., 4.2 miles. *Services*, iron. *Taps*, 155. *Meters*, none. *Hydrants*, Ayers are being replaced by Mathews, 36; 6 being private.

Consumption, not given. *Pressure*, fire, 72 lbs.

Financial.—Cost, $25,000. Debt, $5,000. Int., 5%. Ann. op. exp., construction and repairs, $1,045. Ann. int., $330. Ann. rev.: total, $2,339.

Management.—One Comr., W. A. Hulse.

WATERFORD, *Saratoga Co.* (Pop., 1,822; est., 5,000.) On Hudson river, 4 miles from Troy. Manufactures knit goods, collars, cuffs, stocks and dies, lathes, fire hydrants, valves, steam and hand fire engines, paper and brushes.

History.—Built in '86 by Waterford Water Co., controlled by Moffett, Hodgkins & Clarke, Syracuse, Engrs. and Contrs.

Water Supply.—Hudson river, pumping to tank.

Pumping Machinery.—Dy. cap., 1,000,000; Worthington.

Tank.—No data.

Distribution.—*Mains*, c. i., 8 miles. *Services*, galv. i. *Taps*, 326. *Meters*, 60. *Hydrants*, kind not given, 60.

Consumption, 161,857 galls. *Pressure:* Ordinary, 77 lbs. Fire, 150 lbs.

Financial.—Cost, $72,000. Debt, $72,000. Int., 6%. Ann. op. exp., withheld est., $1,600. Ann. rev.: consumers, withheld, est., $5,000; city, $2,725.

Management.—Prest., M. C. Powell. Supt., W. A. Dennis.

WATERLOO, *Seneca Co.* (Pop., 3,893; est., 5,000.) Manufactures shawls, carriage-wheels, yeast cakes, iron fences, woollen goods, agricultural implements, steam and friction engines, organs and carriages. Incorp. No sewers. Has electric lights.

History.—Built in '86 by Waterloo Water Co. Engr., W. S. Parker. Contr., Edw. Shanley, N. Y. City.

Water Supply.—Seneca river, pumping to stand-pipe and direct.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two Worthington dup., comp., cond. *Boilers:* two 80 H. P. tubular.

Stand-Pipe.—Cap., 172,000 galls.; 15x130 ft.; from Ryan & McDonald, Waterloo.

Distribution.—*Mains*, c. i., 9 miles. *Services*, enam. i. *Taps*, 240. *Meters*, 2. *Hydrants*, Ludlow, 50. *Valves*, Ludlow, *Pressure-recording gauge*, Edson.

Consumption, 160,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 90 lbs.

Financial.—Cost, $100,000. Cap. stock, $40,000. Bonded debt, $60,000. Int., 6%. Ann. op. exp., $1,800. Ann. rev.: consumers, $5,500; city, $2,000. Hydrant rental, $40.

Management.—Prest., Francis Bacon. Secy. and Treas., A. G. Mercer. Supt., Geo. Clark.

WATERTOWN, *Jefferson Co.* (Pop., 10,697; est., 15,000.) On Black river, which furnishes good water-power used in manufacturing. Settled about 1800; incorp. city in '69. Has sewers and electric lights.

History.—Built in '53 by village.

Water Supply.—Black river, pumping to reservoir.

Pumping Machinery.—Dy. cap., 6,000,000 galls.; two dup., water-power, from R. D. Wood & Co., Philadelphia, Pa.

Reservoir.—Cap., 3,250,000 galls.; 150 ft. above river.

Distribution.—*Mains*, 16 to 4-in., c. i. 25 miles; originally w. i. and cem. *Services*, w. i., galv. i. *Taps*, 2,300. *Meters*, 7. *Hydrants*, Holyoke, 200. *Valves*, Eddy.

Consumption, 2,000,000 galls. *Pressure*, 75 lbs.

Financial.—Cost, $300,000. Bonded debt, $235,000. Int., 3 and 7%. Ann. op. exp., $5,000. Ann. rev.: consumers, $20,000; city, $4,800.

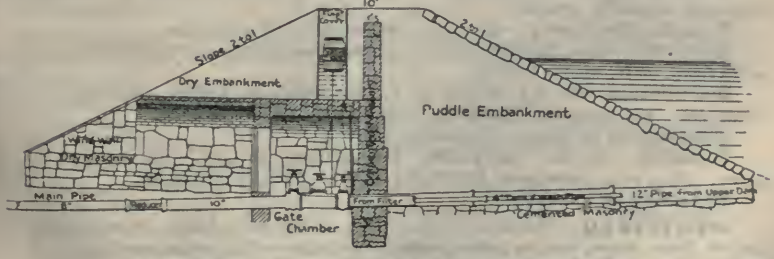
Management.—Five Comrs: Prest., J. C. Knowlton. Clerk, N. B. Wardwell. Supt., A. Salisbury. Report made by F. A. Hinds.

WATERVILLE, *Oneida Co.* (Pop., est., 3,000.) In township of Sangerfield, in hop-raising country. Incorp. No sewers or electric lights.

History.—Built in '88 by village; put in operation Sept., '88. Engr., Wm. B. Rider, So. Norwalk, Conn. Contr., G. W. White, Pulaski.

Water Supply.—Surface water, filtered, by gravity from storage and distributing reservoirs.

Dams and Reservoirs.—Combined cap., 23,500,000 galls. *Storage:* cap., 22,000,000 galls.; area, 6 acres; water surface, 177 ft. above R. R. in village; 26 ft. of water. Dam of earth, with heart-wall; 280 ft. long, 30 ft. high, water 4 ft. below top; 15 ft. wide at top, 165 at bottom. Inner slope, 3 to 1, riprapped 1 ft. thick; outer, 2 to



Distributing Reservoir Dam, Waterville, N. Y.

1. Inner part clay and loam, puddled, with three puddle-filled trenches; outer common earth. Founded on quite compact slate rock. *Heart-wall:* stone masonry in cem.; 16 ft. thick at bottom, 1½ at top; carried 4 ft. below bottom, and within 4 ft. of top of dam. *Spillway:* 50 ft. from end of dam, 24 ft. wide, 4 ft. deep; partly in rock, lined with masonry, free; slope, 13 ft in 100. *Discharge-pipe:* 16-in.; slope, 3 ft.

in 100. *Distributing:* cap., 1,500,000 galls.; 13 ft. of water. Dam similar to storage, on same stream, 400 ft. from, 29 ft. below; 240 ft. long, 17 ft. high. *Spillway:* 25 ft. wide. See filter below. Neither dam leaks. Engrs. and Contrs., see History. Cost, $20,000. See accompanying section.

Filter Dyke.—Gravel; divides distributing reservoir into two parts, lengthwise one for clear, one for filtered water.

Distribution.—*Mains*, c. i., 7 miles. *Services*, c. i. Pipe from Warren Foundry & Machine Co., Phillipsburgh, N. J., and specials from Builders' Iron Foundry, Providence, R. I. *Taps*, 130. *Meters*, none. *Hydrants*, Mathews, 50. *Valves*, Eddy.

Consumption, not given. *Pressure*, 90 lbs.

Financial.—Cost, $60,000. Bonded debt, $60,000. Int., 4%. Ann. op. exp. and rev., not determined.

Management.—Four Comrs. Prest, S. S. Bissell. Secy. and Treas., H. N. Cander. Supt., P. Acting.

WAVERLY, *Tioga Co.* (Pop., 2,767; est., 4,000.) In rolling country, small stream flowing through village. Settled in '40; incorp. village in '55. Has sewers and electric lights.

History.—Built in '80 by Waverly Water Co. Chf. Engr., Peter Hogan, Albany.

Water Supply.—Surface water and springs, by gravity from impounding reservoir. Drainage area, about 2 sq. m.

Dam and Reservoir.—Cap., 93,000,000 galls.; area, 17 acres; 55 ft. of water to bottom of discharge-pipes; 100 ft. above village. Dam of earth, on rock, with heart-wall; 322 ft. long, 60 ft. high, water 5 to 6 ft. below top; top, 10 ft. wide. Inner slope, 2 to 1, 1-ft. paving; outer, 1½ to 1, unpaved. Inner part selected clay, loam, gravel; outer, coarse sand. *Heart-wall:* heavy stone in cement, 8 ft. thick at bottom, 3 at top, 42 ft. high; bottom carried slightly below bottom of dam; 72 ft. long, channelled into rock at each end. *Spillway:* at end, excavated in loam and sand, not lined; 38 ft. long, 9 ft. deep, extends 210 ft. from gates to overfall; controlled by gates 4 ft. high; slope, 4 ins. to 100 ft. *Discharge-pipes:* two 12-in.; supply-pipe works on hinge with float. Dam has small leak. Engr., see History. Built by day labor. Cost, $18,000.

Distribution.—*Mains*, c. i., 8 miles. *Services*, galv. i. *Taps*, 400. *Meters*, 5. *Hydrants*, Mathews, 27.

Consumption, 500,000 galls. *Pressure*, 87 lbs.

Financial.—Cost (in '86), $60,000. Debt, withheld. Ann. op. exp. (in '87), $1,800. Ann. rev.: consumers, withheld, est., $6,000; city, est., $2,000. Hydrant rental, about $75.

Management.—Prest. and Treas., J. T. Sawyer. Secy., J. B. Floyd. Supt., A. J. Vanatta.

WELLSVILLE, *Allegany Co.* (Pop., 2,049.) On Genesee river.

History.—Built in '83 under 25-years franchise to W. Kuhn, of American Water-Works & Guarantee Co., Pittsburg, Pa. Engr., C. W. Knight, Rome.

Water Supply.—Surface water, by gravity and direct pumping to reservoir; originally wholly by gravity.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Worthington.

Reservoir.—Cap., 7,000,000 galls.; in embankment; inner slopes, riprapped, 1⅛ miles from, 185 ft. above, village.

Distribution.—(In '86.) *Mains*, w. i., Converse joint, 6 miles. *Services*, w. i. *Taps*, 210. *Meters*, none. *Hydrants*, Ludlow, 31. *Valves*, Ludlow.

Consumption, not given. *Pressure*, 75 lbs.

Financial.—(In '86.) Cost, $50,000. Debt, $30,000. Int., 6%. Ann. op. exp., not given. Ann. rev.: consumers, $2,500; city, $1,300. Hydrant rental, $40.

Management.—Not given.

WESTFIELD, *Chautauqua Co.* (Pop., 1,921; est., 3,500.) Manufactures leather, flour, paper, woolen goods, baskets, carriages and mowing machines. Incorp. village. No sewers or electric lights.

History.—Built in '89 by village. Engr., Geo. W. Patterson. Contr., C. A. Delafield, N. Y. City. Fire protection system built in '79. For data, see MANUAL for 88.

Water Supply.—Chautauqua creek, filtered, by gravity to reservoir; filtered again, thence by gravity.

Filters.—No data.

Supply Main.—About 16,000 ft., 12-in. vitrified pipe.

Reservoir.—No data.

Distribution.—*Mains*, including supply, about 11 miles. *Hydrants*, 56. Other data not determined.

Financial.—Cost, est., $60,000. Bonded debt, $60,000. Int. 3½%.

Management.—Village Trustees. Prest., G. W. Patterson. Secy., A. E. Pierce Treas., R. G. Wright.

WEST POINT NATIONAL MILITARY ACADEMY, *Orange Co.* (Pop., 1,590.) On rocky point on west shore of, and 167 ft, above, Hudson river. Owned by United States Government; Academy established in '02.

History.—Supplied as early as '40. Present system built in '79. Des. Engr., Maj. O. H. Ernst. Const. Engrs., Maj. Raymond and Capt. Tabor, U. S. Corps of Engrs.

Water Supply.—Mountain stream, by gravity from impounding reservoirs. Stream generally dries up in summer.

Reservoirs.—Combined cap., 58,600,000 galls.; from ¼ to 5 miles from Post; cap., 48,000,000; 300,000; 1,300,000 and 9,000,000 galls. respectively. Larger reservoir covers about 11 acres, is in hills, 4 miles from, and 1,000 ft. above river. Distributing reservoir is 168 ft. above Post.

Filter and Siphon.—Filter at larger reservoir, sand and gravel. Water passes from it to 6-in. c. i. siphon, 900 ft. long.

Distribution.—*Mains*, c. i., about 7 miles. *Meters*, none.

Consumption, 300,000 galls. *Pressure:* Ordinary, 30 lbs. Fire, 70 lbs.

Financial.—Cost, unknown. No debt. Ann. op. exp., about $1,000. No. rev.

Management.—Water supply is in charge of Instructor of Practical Military Engineering, and Post Quartermaster has charge of its distribution. Supt., Capt. G. M. Derby.

WEST TROY, *Albany Co.* (Pop., 8,820; est., 12,000.) On west bank of Hudson river, on low land. The Watervliet U. S. Arsenal was established here in '07. Engaged in manufacturing and lumber trade. Incorp. village in '36. Has sewers and electric lights.

History.—Built in '73-6 by West Troy Water-Works Co.; now controlled by Moffett, Hodgkins & Clarke, Watertown, N. Y., and operated in connection with Green Island plant. See '88 MANUAL for description of former supply and plant. Engr., Palmer H. Baermann Consult. Engr., Stephen E. Babcock, Little Falls. Contrs. for original works, excluding cement mains and pumps, Sherman & Flagler, now Troy Public Works Co.

Water Supply.—Green Island works,

Distribution.—*Mains*, w. i. and cem., 11 miles; furnished and laid by American Water-Works & Gas Pipe Co, now Ferris & Halladay, Jersey City, N. J. *Services*, lead, iron. *Taps*, 584. *Meters*, none. *Hydrants*, kind not given, 87.

Consumption, 1,000,000 galls. *Pressure*, 75 lbs.

Financial.—Cost, $300,000. Cap. stock, $100,000. Bonded debt, $200,000. Int., 6 and 7%. Ann. op. exp., $3,000. Ann. rev.: consumers, $12,000; city, $10,000. Hydrant rental, $100.

Management.—Prest., H. C. Hodgkins. Supt., C. C. Hill.

WHITEHALL, *Washington Co.* (Pop., 4,270, est., 5,000.) At head of Lake Champlain, at mouth of Poultney river. Engaged in boat-building, manufacturing and lumber trade. Incorp. No sewers or electric lights.

History.—Built in '52, and new works built in '84 by village.

Water Supply.—Springs, by gravity, pumping to reservoir and pumping direct.

Dam and Reservoir.—Cap., 5,500,000 galls.; about ½ mile from, and 266 ft. above, village. Dam, originally 260 ft. long.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Davidson comp., cond.

Distribution.—*Mains*, c. i., 8.2 miles. *Services*, galv. i., lead. *Taps*, 340. *Meters*, 17. *Hydrants*, Mathews, 53. *Valves*, Eddy.

Consumption, 200,000 galls. *Pressure*, 110 lbs.

Financial.—Cost, $83,765. Debt, $79,000. Int., 4%. Ann. op. exp., $4,300. Ann. rev.: consumers, $4,500; city, $2,400.

Management.—Secy., and Supt., C. M. Hotchkiss.

WHITE PLAINS, *Westchester Co.* (Pop., 2,381; est., 4,500.) Place of residence for N. Y. City business men, being 22 miles from that city. Incorp. Has sewers and electric lights.

History.—Built in '85 by a private Co., controlled by Moffett, Hodgkins & Clarke, Syracuse.

Water Supply.—Springs, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 1,750,000 galls.; Worthington.

Stand-Pipe.—Cap., 275,000 galls.; 30 x 52 ft.

Distribution.—*Mains*, c. i., 9 miles. *Services*, galv. i. *Taps*, 237. *Meters*, 104. *Hydrants*, kind, not given, 77.

Consumption. 26,480 galls. *Pressure*, not given.

Financial.—Cost, $120,000. Debt, $86,000. Int., 6%. Ann. op. exp., $2,000. Ann. rev.: consumers, $6,000; city, $2,800. Hydrant rental, about $40.

Management.—Prest., J. V. Clarke. Supt. A. L. Fassett.

WHITESBORO, *Oneida Co.* (Pop., 1,371; est., 1,800.) On Sanquvit creek. Settled in '14; incorp. a village in '30. No sewers or electric lights.

History.—Built in '27 by Lyman L. Wight.

Water Supply.—Springs, by gravity from collecting reservoir.

Reservoir.—Is 10 x 12 ft., x 8 ft. deep.

Distribution.—*Mains*, c. i., 2½ miles; cem. pipe was first used, then wood, then c. i. *Services*, w. i. *Taps*, 32. *Meters*, none. *Hydrants*, 1.

Consumption. not given. *Pressure:* Ordinary, 20 lbs. Fire, 60 lbs.

Financial.—Cost, $3,500. No debt. Ann. op., exp., $50. Ann. rev.: consumers, $500.

Management.—By owner, L. L. Wight.

WHITESVILLE, *Allegany Co.* (Pop., not given.) Not incorp. No sewers or electric lights.

General Description.—Built in fall of '88 by Whitesville Water Co. Contrs., Hardwicke & Ware, Buffalo.

Water Supply.—Springs, by gravity to reservoir.

Reservoir.—Cap., 35,000 galls.

Distribution.—*Mains*, 6 and 3-in. c. i., 1 mile. *Services*, galv. i. *Taps*, 23. *Meters*, 1. *Hydrants*, Chapman, 10.

Consumption and *Pressure*, not given.

Financial.—Cost, $3,500. Cap. stock, $3,000. Ann. rev.: consumers, $175; city, $100. Hydrant rental, $10.

Management.—Prest., J. T. Crittenden. Secy., A. C. Howe. Treas., A. D. Howe.

WORCESTER, *Otsego Co.* (Pop., est., 1,500.) In farming country. Not incorp. No sewers or electric lights.

History.—Built in '87 by Worcester Water Co., under 99-years franchise. Engr., Geo. N. Cowan, Stamford. Contr., Francis Leonard, Norwalk, Conn.

Water Supply.—Caryl lake, by gravity. Area of lake, 41 acres.

Distribution.—*Mains*, c. i., 6 miles. *Services*, lead. *Taps*, 35. *Meters*, none. *Hydrants*, Ludlow, 17. *Pressure-valve*, Ross.

Consumption, not given. *Pressure:* Ordinary, 70 lbs. Fire, 90 lbs.

Financial.—Cost, $34,000. Cap. stock, $24,000. Debt, $14,700: $10,000 bonded, rest floating. Int., 6%. Ann. op. exp., $175. Ann. rev.: consumers, $304; city, $500. Hydrant rental, $30.

Management.—Prest. and Supt., Wm. Fern. Secy., S. W. Ferguson. Treas., H. M. Nichols.

YONKERS, *Westchester Co.* (Pop., 18,892; est., 26,000.) On Hudson river, adjoining N. Y. City, but 17 miles from N. Y. city hall. Saw Mill creek empties into Hudson here, flowing through middle of city, affording good water-power, used in various manufactories. Many N. Y. City business men reside here. Incorp. Has sewers and electric lights.

GLENWOOD WATER-WORKS.

General Description.—Built prior to '76; sold at auction, Dec. '88; previous to sale were part of Elsa Bloomer estate.

CITY'S WORKS.

History.—Built in '76 by city. Engr., Wm. W. Wilson, deceased. Consult. Engr., Gen. Geo. S. Greene. In '73 a 2,000,000-gall. reservoir, supplied by springs, had been built and pipes laid in business part of city, for fire protection. This is now known as Lake Avenue distributing reservoir. Part of 24th ward of N. Y. City supplied from these works; in '81 amount furnished was less than 15,000 galls. a day.

Water Supply.—Sprain and Grassy Sprain brooks, pumping from impounding to distributing reservoir, and direct pumping. Valleys of both streams are underlaid by primitive rock. Drainage area, 4.87 sq. m.: Sprain brook, 2.75; Grassy brook, 2.12 sq. m.

Diverting Dam.—Masonry, small, to turn water into canal. Flow to canal is governed by two gates, formed by stop-planks running in grooves in masonry. *Spillway:* 20 ft. wide; can be used to turn stream into original channel.

Canal.—From diverting dam to Grassy Sprain reservoir; 3,300 ft. long, 5 ft. wide at bottom; slopes 1½ to 1, paved 1 ft deep with dry stone on edge, carried 1 ft. above water line; planned to carry 4½ ft. of water during freshet. Several falls in lower part serve to aerate water.

Grassy Sprain Dam and Reservoir.—Cap., 406,000,000 galls.; area, 101 acres; av. depth, 12½ ft.; max. depth, 26 ft.; 113 ft. above mean tide, divided into two basins by embankment for roadway; basins connected by arched channel 12 ft. wide. Sides of natural basin rise quite abruptly from bottom, and are rocky or composed of sand and gravel. Site was cleared of timber undergrowth and brush, and for a certain distance [not stated] from flow-line stumps were grubbed out. About 40 acres of site is covered with peat from 2½ to more than 25 ft. deep. Some 20 acres of this peaty area were flooded from 1½ to 5 ft. in depth during summer before filling reservoir. Though water was so shallow at the end of summer it did not become objectionable, so peaty bottom was allowed to remain without covering or other treatment. Material at site of dam consisted mainly of coarse sand and fine gravel, there were also layers of quicksand. At west end of dam rock rises above flow-line but falls abruptly at each side, being 40 ft. below surface at bottom of valley. At east end of dam, beginning at the foot of slope, hardpan was found from 12 to 20 ft. beneath surface.

Dam of earth with heart-wall; little over 400 ft. long, 30 ft. high, water 4 ft. below top; 20 ft. wide on top. Slopes, both 2 to 1, inner faced with 1½ ft. riprap; outer, sodded. Built of earth taken near by, stones above 2 ins. in diam., excluded; in 6-in. layers, moistened and rolled. *Heart-wall:* puddle, on concrete and masonry foundation. From rock at west end to hardpan at east, heart-wall below natural surface confined by two rows sheet-piling, 15 ft. apart; 8 x 10 spruce, driven 10 to 30 ft., extending well into slopes of valley, at one side footing on rock, at other on hardpan. Space between piles excavated 10 to 19 ft. and filled with 2 to 4½ ft. of concrete. At deepest part of trench quicksand was encountered and removed to gravel; here sheet-piling of yellow pine plank was driven 5 to 6 ft. into gravel, tops of same extending into concrete above. On rock at west end wall of rubble masonry in cement, 3 ft. high, 3 ft. wide, was built, forming the center of bottom of puddle wall here, and extending into concrete. After all this work had been done space above was filled with gravel puddle to top of rows of piling, above which wall is stepped from thickness of 14 to about 5 or 6 ft. Excavation outside of piling was carefully filled with selected material. *Spillway:* at and in west end of dam, on rock, lined with rubble masonry in cement, free; 25 wide, 325 ft. long to point of discharge in stream below; descent effected by low falls with level stretch between. *Discharge-pipe:* 48-in., connecting with supply-main and provided with gate at lower end for waste purposes, if desired; 83 ft. long, supported by piles, enveloped in concrete and rubble masonry, having frequent projections all around. *Gate-houses:* one at each end of pipe; inner has 4 gates for taking water at different depths, and has screens at mouth of discharge-pipes; outer contains 48-in. gate and branch for supply-main,

Dam leaks slightly, but no increase in 10 years. Built in '76. Engr., see History. Contrs., Davis & Kelly. Cost, $73,750, including all work described.

Conduit.—To pumps; diam., 24 ins.; length, 3,552 ft.

Pumping Machinery.—*Low service:* cap., 5,750,000 galls.; 2,500,000 Wright, 3,500,000 Worthington. *High service:* cap., 3,000,000 galls.; 1,000,000 and 2,000,000 Worthington, latter added in '88.

Force Main.—To distributing reservoir; 18-in., 8,525 ft. long; first 4,000 ft. rises to top of Fort Field hill, 297 ft. above tide, where a length of pipe is set vertically, with self-acting air-valve at top; this length encased with 12 ins. tar concrete, then 12 ins. brick masonry. From here main descends to reservoir.

Lake Avenue Distributing Reservoir.—Cap., 4,000,000 galls.; about 1 mile from city. Built in '73 for fire protection, and enlarged since '76 from 1,750,000 galls. to present cap.

High Service Tank.—Cap., 40,000 galls.; in octagonal brick tower, 98 ft. high; bottom of tank 418½ ft. above tide-level. Tank 18½ ft. in diam., 31 ft. high; boiler-iron ½-in. thick at bottom, 1-16-in. at top. Placed on floor of double I beams sustaining weight of 3,800 lbs. per sq. ft. Contr. for tank, David M. Nichols, New York; for other work, Dennis Murphy, Yonkers,

Distribution.—(Dec. 1, '88.) *Mains*, c. i., 34¾ miles. *Services*, lead. Since '74 mains have been coated with Dr. Angus Smith's preparation. Mains always tested for leaks, under full head, before trench is filled. In '79 a joint started in 18-in. main, permitting jet of water to escape under 85 lbs. pressure, causing earth around to act as a sand blast, and wearing a hole in the spigot end of pipe in front of jet. *Taps*, 2,304. *Meters*, 1,776; mostly Crown, with some Union, Rotary, Worthington, Gem, Empire, Equitable and Union duplex. *Hydrants*, Mathews, 387. *Valves*, McLean. *Pressure-recording gauge*, Edson.

Consumption, 2,015,775 galls. *Pressure*, 130 lbs.

Financial.—Cost, $861,423. Bonded debt. $815,000: $625,000 at 7, $30,000 at 5, $160,000 at 4%. Sinking fund, $50,370. Ann. op. exp., $26,113. Ann. rev.: consumers, $57,813; city, $11,160. Hydrant rental, $30.

Management.—Five Comrs. Clerk and Supt., Jos. A. Lockwood.

Reference.—Further details, map of village, plan and section of dam are given in Annual Report Water Board for '76.

Water-Works Projected with Fair Prospects of Construction.

AMITYVILLE, *Suffolk Co.* See Babylon.

BABYLON, AMITYVILLE and BRESLAU, *Suffolk Co.* (Pop., Babylon, est., 2,800.) Babylon, on Long Island, on Great South Bay, 35 miles from Brooklyn. Summer resort. Other villages near by. Babylon has electric lights.

Proposed Works.—Unofficially reported, Feb., '90, that local company was to be organized, raising $20,000 in cash, and issuing $55,000 of bonds. Address Edw. Sammiss.

BRESLAU, *Suffolk Co.* See Babylon.

BROCKPORT, *Monroe Co.* (Pop., est., 6,000.) Is 17 miles west of Rochester. Manufactures agricultural implements. Incorp. village. No sewers. Has electric lights.

Proposed Works.—Dec. 21, '89, preliminary work was in progress by Brockport Water Co., which has franchise. Works to be in operation by Aug. 1, '90. Cap. stock, $85,000. Hydrant rental, $2,800 a year for all. Engrs., Bassett Bros. Prest., C. M. Harrington. Secy., E. M. Bassett. All of Buffalo. Date of report, Dec. 21, '89.

CARTHAGE, *Jefferson Co.* (Pop., 1,912; est., 3,000.) On Black river, 16 miles from Watertown. Engaged in manufacturing. Has electric lights.

Proposed Works.—Unofficially reported Fall of '89 that town had voted $50,000 for construction of works. For earlier projects see MANUAL for '88, p. 147.

CATTARAUGUS, *Cattaraugus Co.* (Pop., est., 1,200.) Has small manufactories.

Proposed Works.—Under consideration. Nothing definite decided. Jan. 14, '90.

COXSACKIE, *Greene Co.* (Pop., 1,661.) Is 21 miles from Albany. Has various manufactories

Proposed Works.- Board of Trade were considering works in '89. Jan. 23 project was being discussed. Address, R. H. Van Bergen.

ELLICOTTSVILLE, *Cattaraugus Co.* (Pop., 748; est., 1,000.) In agricultural district.

Proposed Works.—Co. hopes to build summer of '90. Supply, springs, by gravity to and from reservoir. Est. cost, $7,000 to $10,000. Stock subscriptions amounting to $3,500 secured and remainder promised. C. P. Vedder interested. Report by E. S. King; date, Feb. 28, '90.

HOLLEY, *Orleans Co.* (Pop., 1,018; est., 2,500.) Is 22 miles from Rochester. Engaged in trade and manufacturing. Incorp. village. Has electric lights.

Proposed Works.—Dec. 21, '89, Holley Water-Works Co. were doing preliminary work. Engrs., Bassett Bros. Cap. stock, $45,000. Rev. expected from city, 1,125. Works to be in operation Aug. 1, '90. Prest., C. M. Harrington. Secy., E. M. Bassett, all of Buffalo.

LIBERTY, *Sullivan Co.* (Pop., 478; est., 600.) In agricultural section.

Proposed Works.—Co. organized Aug. 1. '89; expect to build in '90. Cap. stock, $20,000. Address Geo. N. Cowan, Stamford.

MONROE, *Orange Co.* (Pop., town, 5,096.) See Tuxedo Park.

SKANEATELES, *Onondaga Co.* (Pop., 1,669; est., 2,200.) On Skaneateles lake, 18 miles from Syracuse. Has manufactories. Summer resort.

Proposed Works. Skaneateles Water Co., build. Projected for '89, postponed to '90. Supply, Skaneateles lake, pumping to stand-pipe. Est. cost, $35,000. Prest., Geo. Barrow. Date of latest report, Oct. 1, '89.

TUXEDO PARK, *Orange Co.* (Pop., not given.)

Proposed Works.—Unofficially reported, Nov. '89, that Tuxedo Water Co. had been formed to build works to supply town of Monroe. Cap. stock, $100,000.

Water-Works Projects Reported in '89 and '90, but Now Indefinite.

Altamont, Albany Co. *Amenia*, Dutchess Co.; see MANUAL for '88, p. 147. *Cazenovia*, Madison Co. *East Randolph*, Cattaraugus Co. *Franklinville*, Cattaraugus Co. *Perry*, Wyoming Co. *Pike*, Wyoming Co. *Portage*, Portageville P. O., Wyoming Co. *Spring Valley*, Rockland Co. *Watkins*, Schuyler Co.

NEW JERSEY.

Water-Works Completed or in Process of Construction.

ASBURY PARK, *Monmouth Co.* (Pop., 1,610; est., 3,500.) Faces Atlantic Ocean, and is noted summer resort. Incorp. Has sewers and electric lights.

History.—Put in operation June 30, '86, by village; under construction, '85-8. Engr., Isaac S. Cassin, Philadelphia, Pa.

Water Supply.—Artesian wells, pumping to stand-pipe. Separate plant for street sprinkling consisting of pumps and pipe-line; water taken from pond.

Pumping Machinery.—Dy. cap., 1,750,000 galls.; two 500,000 and one 750,000 Gaskill dup.

Stand-Pipe.—Cap., 105,000 galls., 12 x 125 ft.; from R. Tippett's Sons, Harrisburg, Pa.

Distribution.—*Mains*, c. i., 13.7 miles. *Services*, galv. i., lead. Pipe and specials from Ormrod, Fisher & Co., now Donaldson Iron Co., Emaus, Pa.; Mellert Foundry & Machine Co., Reading, Pa.; Union Hydraulic Works, Philadelphia, Pa. *Taps*, 547. *Meters*, 80. *Hydrants*, Cassin, 60. *Valves*, kind, do.

Consumption, not given. *Pressure*, 60 lbs.

Financial.—Cost, $92,000. Bonded debt, $92,000. Int. 5%. Ann. op. exp., $6,000. Ann. rev.: consumers, $7,862, city, $3,500.

Management.—Comrs. Secy. and Supt., G. H. Coffin.

ATLANTIC CITY, *Atlantic Co.* (Pop., 5,477; est., 8,000; summer, 15,000 to 125,000.) On island separated from mainland by 5 miles of marsh land. Summer resort. Settled and incorp. in '82. Has sewers and two electric lights.

ATLANTIC CITY WATER-WORKS CO.'S PLANT.

History.—Built in '83 under a 99-years franchise. Des. Engr., J. D. Cook, Toledo, O. Const. Engr., E. Graves, Contrs., R. D. Wood & Co., Philadelphia, Pa.

Water Supply.—Wells and streams, pumping to stand-pipe. Well is 25 ft. in diam., 26 ft. deep and connected by 500 ft. of 24-in. earthen pipe with a creek.

Pumping Machinery.—Dy. cap., 8,000,000 galls.; 3,000,000 and 5,000,000 Worthington, latter added in '88 or '89.

Force Mains.—*Old:* no data. *New:* 20-in., 6 miles long; laid across meadows from Pleasantville in '89.

Stand-Pipe.—Cap., 454,700 galls.; 25 x 132 ft. In erecting stand-pipe a float was placed inside, and water pumped in as each ring was added, float serving as plat form for workmen.

Distribution.—*Mains*, c. i., 25 miles. *Services*, w. i. *Taps*, withheld. *Meters*, 424. *Hydrants*, Mathews, 150. *Pressure-recording gauge*, Edson.

Consumption, 500,000 to 2,000,000 galls., according to season. *Pressure*, 50 lbs.

Financial.—Cost, withheld, est., $500,000. Cap. stock, $250,000. Bonded debt, $375,000: $250,000 at 6, $125,000 at 5%. Ann. op. exp., withheld, est. $7,000. Ann. rev.: consumers, withheld, est., $60,000; city, about $7,500. Hydrant rental, $50.

Management.—Prest., Walter Wood. Secy. and Supt., Geo. T. Prince. Treas., Aaron Fries.

CONSUMERS' WATER CO.'S PLANT.

History.—Built in '88-9; put in operation Feb., '89. Des Engr., M. M. Moore.

Water Supply.—Artesian wells, by pumping to stand-pipe or direct.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; Smith & Vaile comp., dup.

Stand-Pipe.—Cap., 198,750 galls.; 15 x 150 ft.; from Tippett & Wood, Phillipsburgh.

Distribution.—*Mains*, 16 to 4-in. c. i., 15 miles. *Services*, w. i. Pipe and special from McNeal Pipe & Foundry Co., Burlington; laid by Water Co. *Taps*, 500. *Meters*, none. *Hydrants*, Galvin, 100. *Valves*, Ludlow.

Consumption, 500,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 100 lbs.

Financial.—Cost, $175,000. Cap. stock, $150,000. No bonded debt. Hydrant rental, none. Further data not determined.

Management.—Prest., Thos. K. Reed. Secy., W. H. Bartlett. Treas., Fred'k Hemsley.

BAYONNE CITY, *Hudson Co.* (Pop., 9,372; est., 18,000.) On tongue of land extending south from Jersey City. Includes Pamrapo, Bayonne, Centreville and Bergen Point. Place of residence for many N. Y. City business men. Incorp. Has sewers. No electric lights.

History.—Built in '82 by city.

Water Supply.—Jersey City water-works.

Distribution.—*Mains*, c. i. (in '87), 11 miles. *Services*, galv. i., lead. *Taps*, 559. *Meters*, 680. *Hydrants*, Jonson, 110. *Valves*, Jonson.

Consumption, 1,000,000 galls. *Pressure*, 50 lbs.

Financial.—Cost, $135,000. Debt, $120,000. Int., 5%. Ann. op. exp., $4,700. Ann. rev.: consumers, $54,000; city, none.

Management.—Supt., M. O'Connor.

BELLEVILLE, *Essex Co.* (Pop., township, 3,004.) See Newark.

BELVIDERE, *Warren Co.* (Pop., 1,773; est., 2,000.) On Pequest river, near its junction with Delaware, in rolling country. Has water-power used in manufacturing. Incorp. Has sewers and electric lights.

History.—Built in '77-8 by Belvidere Water Co. Des. Engr., E. G. Weir, Belvidere. Const. Engr., Jno. H. King, present Supt. Contr., Conrad Miller, Blairstown. Sub-contr., Geo. I. Gardner, Belvidere.

Water Supply.—Delaware river, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Blake dup.

Stand-Pipe.—Cap., 33,920 galls.; 6x160 ft. high; from Barber & Son, Allentown, Pa.

Distribution.—*Mains*, c. i., 3 miles. *Services*, galv. i. Pipe and specials from Jno. J. Fisher, Allentown, Pa.; Warren Foundry and Machine Co., Phillipsburgh. *Taps*, 175. *Meters*, none. *Hydrants*, Chapman, 18. *Valves*, from B. E. Lehman, Bethlehem, Pa.

Consumption, 90,000 galls. *Pressure*, 77 lbs.

Financial.—Cost, $23,500. Cap. stock, $23,500. No debt. Ann. op. exp., $1,800. Ann. rev.: consumers, $2,484; city, $600. Hydrant rental, $33.33.

Management.—Prest., D. C. Blair. Secy., Treas., Supt., Jno. H. King.

BEVERLY, *Burlington Co.* (Pop., est., 1,800.) On Delaware river.

History.—Not given. Built in or prior to '86.

Water Supply.—Delaware river, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Gordon, erected in '86.

Stand-Pipe.—Cap., not given; height, 120 ft.

Distribution.—*Mains*, 6¼ miles. *Hydrants*, 44.

Financial.—No data.

Management.—Supt., Henry Stetser. Town Clerk, E. C. Higgins.

BLAIRSTOWN, *Warren Co.* (Pop. est., 500.) In agricultural section.

History.—Built in '89 by Jno. I. Blair. No Engr. Contrs., Tippett & Wood, Phillipsburgh.

Water Supply.—Spring, pumping to stand-pipe. Spring 350 ft. from pump.

Pumping Machinery.—Dy. cap., not given; water-power. *Water-wheel:* 14-in. turbine, under 29-ft. head.

Stand-Pipe.—Cap., 112,000 galls., 15x85 ft.; 70 ft. above pumps; from Contrs.

Distribution.—*Mains*, 6 to 4-in., about 3 miles.

Financial.—Cost, about $40,000.

Management.—Owner, Jno. I Blair. Date of report, Mar. 3, '90.

BLOOMFIELD, *Essex Co.*, See East Orange.

BORDENTOWN, *Burlington Co.* (Pop., 4,258; est., 5,000.) On Delaware river on ground about 60 ft. above river. Engaged in manufacturing. Settled early in last century.

History.—Built in '56 by Bordentown Reservoir and Water Co. Engr., Jas. W. Allen. In Jan., '83, building belonging to these works was burned and pumping machinery was ruined.

Water Supply.—Delaware river, filtered, pumping to reservoir.

Pumping Machinery.—Dy. cap., 500,000 galls.; Worthington comp., dup., with 20 and 14-in. steam and 10-in. water cylinders, all of 9-in. stroke.

Filter.—National.

Force Main.—Diam., 6 ins.; length, 5,400 ft.; rise, about 100 ft.

Reservoir.—Cap., 684,466 galls.; in excavation and embankment.

Distribution.—*Mains*, c. i., 5 miles. *Services*, not given. *Taps*, withheld, est., 400. *Meters*, 7. *Hydrants*, Mathews, 42.

Consumption, not given. *Pressure:* Ordinary, 33 lbs. Fire, 80 lbs.

Financial.—Original cost, $40,000. Cap. stock (in '82), $30,000. Debt, $6,300. Int., 6%. Ann. op. exp., withheld, est., $1,000. Ann. rev.: consumers, withheld, est., $10,000; city, $600. Hydrant rental, $14.29.

Management.—Prest., W. Steele. Treas., J. B. Woodward. Supt., Jno. M. Steele.

BRIDGETON, *Cumberland Co.* (Pop., 8,922; est., 11,000.) On both sides Cohansy river, 37 miles from Philadelphia, in gently undulating region. Manufactures glass iron and nails. Incorp. No sewers. Has electric lights.

History.—Built in '77-8 by village. Engr., Isaac S. Cassin, Philadelphia.

Water Supply.—East lake, springs and well, pumping to reservoir. Lake has area of 30 acres. Well, 28 ft. deep, 30 ft. in diam., was dug in '87 and connected with pumps by 75 ft. of 16-in. suction pipe. Contr., J. H. Hanes, Cape May.

Impounding Reservoir.—Cap., 3,000,000 galls.; impounds overflow of lake.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; 1,000,000 Worthington, and 500,000 Blake dup.

Force Mains.—C. i., 16-in., 2,300 ft. long; 87 ft. head on pumps.

Reservoir.—Cap., 1,350,000 galls.; in excavation and embankment, 88 ft. above lower reservoir, 103 ft. above and one mile from village; 96 ft. sq. at bottom, 135 at at top, 15 ft. deep; in two divisions. Inner slopes, 1¾ to 1, lined with brick.

Distribution.—*Mains*, c. i., 16.1 miles. *Services*, galv. i. *Taps*, 1,154. *Meters*, 7. *Hydrants*, 105, Mellert Foundry & Machine Co's, Reading, Pa.; Cassin. *Valves*, kind, d

Consumption, 261,361 galls. *Pressure*, 46 lbs.

Financial.—Cost, to Feb. 1, '89, $104,921. Debt, $74,000. Int., 6%. Ann. op. exp., $2,930. Ann. rev.: consumers, $12,050.

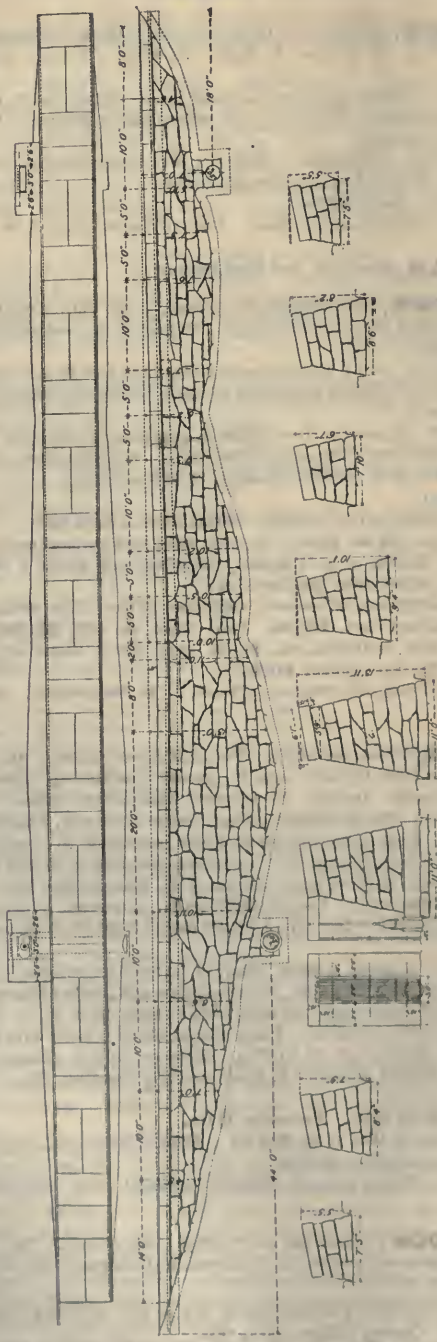
Management.—Water Com. of Common Council. Sec. and Supt., Timothy Woodruff.

BOUND BROOK, *Somerset, Co.* (Pop., est., 1,500.) On Raritan River. Has large lumber trade and woolen and other manufactories. No sewers. Electric lights completed Oct. '89.

History.—Built in '88-9 by Bound Brook Water Co.; formally opened Sept. 2, '89. Engr., Isaac S. Cassin, Philadelphia, Pa.

Water Supply.—Middle brook, by gravity.

Dams and Reservoirs.—Cap., about 10,700,000 galls.; areas, 1 and 5 acres respectively. Dams of stone, known as Nos. 1 and 2, latter, storage; former, distribu-

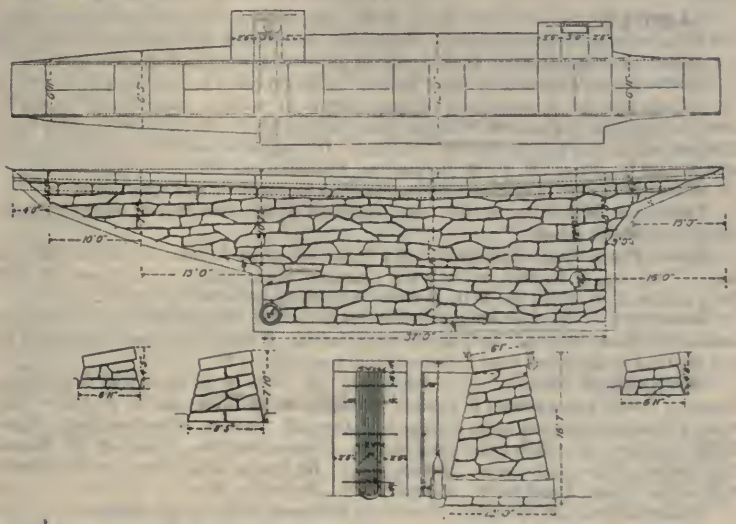


Dam on Middle Brook, Bound Brook, N. J.—Plan, Elevation and Cross-Section.

ting. See cuts for further data. Built in '88. Des. Engr., see History. Const. Engr., Sylvanus Ayres, Jr. Contrs., Wright & Hughes, Newtown, Conn. Cost, $8,500.

Distribution.—(Sept. 1, '89.) *Mains*, 12 to 4-in. c. i., 5 miles. *Services*, w. i., lead. Pipe from Donaldson Iron Co., Emaus, Pa. Specials, valves and hydrants, from Union Hydraulic Works, Philadelphia, Pa.

Pressure, 45 lbs.



Dam on Middle Brook, Bound Brook, N. J.—Plan, Elevation and Cross-Sections.

Financial.—Cost (Sept. 1, '89), $35,000. Cap. stock, authorized, $40,000. No debt. Hydrant rental $30, Further data not determined.

Management.—Prest., Jas. M. Thompson. Secy. and Treas., W. B. R. Mascn. Mgr, Sylvanus Ayres, Jr.

BURLINGTON, *Burlington Co.* (Pop., 6,090; est., 8,509.) On east bank of Delaware river, on low, level ground, 18 miles from Philadelphia. Engaged in commerce and manufacturing. Founded in 1677. Incorp. No sewers. Has electric lights.

History.—Built in '04; extended in '77 by city, with Isaac S. Cassin, Philadelphia, Pa., as Engr.

In '04 an Aqueduct Co. brought water from springs on high ground south of village. Pipes were of wood 2-in bore, purchased from city of Philadelphia, where they had been in service many years, and then replaced with iron pipes. Supply was so limited, and regulations to prevent its use so strict, that prominent citizen was fined $5 for giving some of this water to a horse.

In '43 Thos. Dugdale laid iron pipes through several streets and pumped into them from river, by steam pump in mill owned by him. He provided 25 fire hydrants free of charge, for privilege of furnishing water to consumers. In '44 his mill was burned, and he erected another pumping engine and 7 iron tanks, placed 50 feet above ground on masonry foundation. In '48 Mr. Dugdale purchased the property of the Aqueduct Co., and erected an 8-H. P high-pressure engine and a 200,000-gall. pump. In '60 works passed into the hands of the Burlington Water-Works Co.; in '77 they were purchased by city and extended.

Water Supply.—Delaware river, pumping to tank and stand-pipe.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; 500,000 Worthington comp., cond., 1,500,000 Gaskill horizontal.

Tank.—Cap., 100,000 galls.

Stand-Pipe.—Cap., 282,000 galls.; w. i., 20 x 120 ft., on stone foundation; from Morris, Tasker & Co.

Distribution.—*Mains*, c. i., 9 miles; laid by Inman Bros., N. Y. City. *Services*, lead. *Taps*, 1,650. *Meters*, none. *Hydrants*, Mathews, 112. *Valves*, Eddy.

Consumption, 350,000 galls. *Pressure*, 55 lbs.

Financial.—Cost, $91,000. Debt, $86,500. Int. 4%. Ann. op. exp., $6,000. Ann. rev.: consumers, $12,000.

Management.—Five Comrs. Treas. and Supt., Geo. A. Allison. Secy., J. F. Budd.

CAMDEN, *Camden Co.* (Pop., 41,659; est.. 70,000.) On Delaware river, opposite Philadelphia, on level ground. Engaged in commerce and manufacturing, and is a suburb of Philadelphia. Incorp. city in '28. Has sewers and electric lights.

History.—Now owned by city; built in '53 by private Co. and bought by city in '70. Water first led to pump-well through 2,880 ft. of wooden conduit, and raised by Cornish pumping engine and Whiting pump as auxiliary. In '70 Worthington high-pressure pump was put in place of Whiting. In engine-house was plate iron stand-pipe, 5 x 129 ft. Engr., H. P. M. Birkinbine, Philadelphia, Pa.

Water Supply.—Delaware river, pumping to reservoir and stand-pipe.

Pumping Machinery.—Dy. cap., 15,000,000 galls.; 5,000,000 and 10,000,000 Blake. *Boilers:* Hilles & Jones.

Stand-Pipe.—Cap., 42,000 galls.; 10 x 75 ft.; on stone foundation, 18 ft. diam. at base, 15 at top, 13 ft. high, with brick chamber 12 ft. high. C. i. bottom, 2½ ins. thick; sides, 5/8 in. thick for 20 ft., 9-16 for 20, 3/8 for 20, ¼ in. thick for 15 ft.

Reservoir.—Cap., 7,500,000 galls; 180 x 344 ft., x 20 ft. deep; in excavation and embankment; inner slopes, 1 to 1, paved with brick. When works were purchased by city 600 tons of sediment were removed from reservoir.

Distribution.—*Mains,* c. i., 55.8 miles. In '70 a 30-in. main was laid across Cooper's creek, being placed in trench, dredged, 200 ft. long and 22 ft. below high water; flexible joint was used, designed by Jacob H. Yocum. *Services,* lead. *Taps,* 12,336. *Meters,* 18. *Hydrants,* Galvin, 404. *Valves,* Galvin. *Close of* '70: Mains, 19.74 miles. Taps, unknown. Meters, none. Hydrants, 102. *Close of* '80: Mains, 35.07 miles. Taps, about 6,000. Meters, none. Hydrants, 267.

Consumption, 5,567,436 galls. *Pressure:* Ordinary, 20 lbs. Fire, 60 lbs.

Financial.—Cost, $1,100,000. Debt, $500,000: $400,000 at 7, $100,000 at 4%. Ann. op. exp., $20,000. Ann. rev.: consumers, $112,302; city, none. Cost close of '70, $365,000; '80, $564,000. Rev., '80, $58,051 .

Management.—Comrs. Prest., Robert S. Barber. Secy., W. B. Doyle. Supt. W. W. Mines. Clerk and Registrar, Wm. B. Doyle.

CAPE MAY CITY *Cape May Co.* (Pop., 1,699; est., 1,800.) On Atlantic Ocean, at southern point of State. Summer resort. Has electric lights.

History.—Built in '74 by city under direction of Council.

Water Supply.—Surface wells, by gravity to tanks, with pumping as auxiliary.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Worthington.

Tanks.—Cap., 130,000 galls.

Distribution.—(In '87.) *Mains,* c. i., 5 miles. *Services,* not given. *Taps,* withheld, est., 180. *Meters,* none. *Hydrants,* Mathews, 75.

Consumption, 100,000 galls. *Pressure:* Ordinary, 24 lbs. Fire, 80 lbs.

Financial.—(In '87.) Cost, $35,000. Debt, $10,000. Int., 5 and 6%. Ann. op. exp., $1,500. Ann. rev.: consumers, $400; city, $5,600.

Management.—Comrs. Supt (in '88), H. F. Douglas.

NOTE.—No response to inquiries sent in '89.

CHAMBERSBURG, *Mercer Co.* (Pop., 5,437.) See Trenton.

DOVER, *Morris Co.* (Pop., 2,958; est., 4,000.) In Randolph township, 42 miles from N. Y. City. In iron mining district, and engaged in manufacturing. No sewers. Has electric lights.

History.—Built in '87 by Dover Water Co., under 10-years franchise. Engr., Isaac S. Cassin, Philadelphia, Pa. Contract for works let, but contractor abandoned his job when about half done.

Water Supply.—Springs, by gravity from collecting reservoir. Dy. yield, 300,000 galls.

Collecting Pipes.—Terra cotta, 15,321 ft.

Reservoir.—Cap., 6,000,000 galls.

Distribution.—*Mains,* c. i., 6.36 miles; from Donaldson Iron Co., Emaus, Pa. *Services,* lead, galv. i. *Taps,* 58. *Meters,* 25. *Hydrants,* Cassin, 40. *Valves,* Cassin.

Consumption, about 10,000 galls. *Pressure,* 75 lbs.

Financial.—Cost, withheld, est., $60,000. Debt, not given. Ann. op. exp., withheld, est., $1,100. Ann. rev.: consumers, est., $1,000; city, $2,000. Hydrant rental, $10.

Management.—Prest., Archer N. Martin. Secy., Chas. E. Kimball. Treas., C. C. Pomeroy. Supt., Philip J. H. Bassett.

EAST ORANGE and BLOOMFIELD, *Essex Co.* (Pop.; East Orange, 8,349; est., 10,000. Bloomfield, 5,748; est., 6,500.) On undulating ground, near N. Y. City; suburban residence villages. East Orange, settled about 1666, and set off from township of Orange in '62. Incorp. a township. Has sewers. No electric lights.

History.—Built in '82 by Orange Water Co; officers of Co. served as Engrs. Charter perpetual.

Water Supply.—Springs and wells, by direct pumping. Wells are 24, 50 and 100 ft. in diam., respectively, and from 85 to 103 ft. deep, in sandstone. Water rises 3 ft. above surface of ground.

Pumping Machinery.—Dy. cap., 2,500,000 galls.; 2,000,000 Gaskill horizontal of 12-in. diam. and 18-in. stroke; 500,000 Worthington.

Distribution.—*Mains*, c. i., 50 miles. *Services*, lead. *Taps*, (in '85) 800; present, est., 1,500. *Meters* (in '85), Crown, Equitable 150. *Hydrants*, Ludlow, 350. *Valves*, Ludlow.

Consumption, 650,000 galls. *Pressure*, 85 lbs.

Financial.—Original cost, $105,000; present cost, est., $500,000. Cap. stock, authorized, $600,000. No debt in '86. Ann. rev.: consumers, withheld, est., $35,000; city, about $20,000. Hydrant rental, $60.

Management.—Prest., F. M. Shepard. Secy., F. M. Shepard, Jr. Treas., J. A. Minett. Supt., Geo. P. Olcott.

ELIZABETH, *Union Co.* (Pop., 28,229; est., 35,000.) On Elizabeth river, and south end of Newark bay, on level land about 11 miles from N. Y. City. Engaged in manufacturing and domestic commerce, business part of city being known as Elizabethport. Settled in 1665, called Elizabethtown until '52, incorp. city in '65. Has sewers and electric lights.

History.—Built in '54 by Elizabeth Water Co., under perpetual charter. Const. Engr., L. B. Battin, present Chf. Engr.

Water Supply.—Elizabeth river, pumping from impounding to distributing reservoir and direct. Drainage area, about 40 sq. m.

Impounding Reservoir.—Cap., 200,000,000 galls.

Conduit.—To filter; w. i and cem., 24-in., about one mile long.

Filter.—Gravel, sand and charcoal, in alternate layers; 8 x 150 ft., x 8 ft. deep.

Clear Water Basin.—Cap., 50,000,000 galls.; near filter and pumps.

Pumping Machinery.—Dy. cap., 7,000,000 galls.; 2,500,000 Worthington and Davidson.

Distribution.—*Mains*, w. i. and cem., 46 miles. *Services*, galv. i. *Taps* 3,250. *Meters*, 30. *Hydrants*, Ayers, 220.

Consumption, 2,500,000 galls. *Pressure*, 30 lbs.

Financial.—Cost, $1,000,000. Cap. stock, $250,000. Bonded debt, $500,000: $100,000 at 7, $400,000 at 4%. Ann. op. exp., $25,000. Ann. rev.: consumers, $80,000; city, $5,500. Hydrant rental, $25.

Management.—Prest., Jno. Kean, Jr. Secy. and Treas. G. M. Ross. Supt., Wm. Whelan.

ENGLEWOOD. *Bergen Co.* (Pop., township, 4,076.) Place of residence for N. Y. City business men, 15 miles from that city. See Hoboken.

FLEMINGTON. *Hunterdon Co.* (Pop. 1,751; est. 2,000.) Center of peach trade.

History.—Built in '64 by Flemington Water Co.

Water Supply.—Springs and river, by gravity (probably), and pumping to reservoir.

Distribution.—(In '87.) *Mains*, 6 to 4-in. c. i., 10 miles. *Hydrants*, 13.

Financial.—No data.

Management.—Supt., J. C. Hopewell.

NOTE.—No response to inquiries sent in '89.

GLOUCESTER CITY, *Camden Co.* (Pop., 5,347; est., 5,500.) On Delaware river, below Camden and near Philadelphia. Summer resort. Engaged in manufacturing. Sewers projected. Has electric lights.

History.—Built in '83-4 by city. Engr., H. P. N. Birkinbine, desceased. Contr., Jno. E. Esbach.

Water Supply.—Springs and Newtown creek, pumping from reservoir to stand-pipe.

Reservoir.—Cap., 2,000,000 galls.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; Wetherill comp.

Stand-Pipe.—Cap., 145,000 galls.; 18 x 75 ft.; from Jno. Baisley.

Distribution.—*Mains*, c. i., 10 miles. *Services*, galv. i. *Taps*, 565. *Meters*, none. *Hydrants*, Adams, 66.

Consumption, 75,000 galls. *Pressure:* Ordinary, 45 lbs. Fire, 80 to 90 lbs.

Financial.—Cost, $82,000. Debt, $82,000. Int., 4 and 6%. Ann. op. exp., $2,222. Ann. rev.: consumers, $4,126.

Management.—Engr., Jas. Finley.

GUTTENBERG, *Hudson Co.* (Pop., township, 1,206.) See Hoboken.

HACKENSACK, *Bergen Co.* (Pop., 4,248.) On Hackensack river, 13 miles from N. Y. City. Residence of N. Y. City business men.

History.—First supplied in '74; now supplied by Hackensack Water Co., reorganized, of Hoboken, which see.

HACKETTSTOWN, *Warren Co.* (Pop., 2,502; est., 2,600.) On Musconetcong river, in valley between hills 400 to 600 ft. high. Highest elevation in State is within ½ mile of town. Engaged in manufacturing. Settled about 1750; incorp. town in '53. No sewers. Has electric lights.

History.—Built in '60 by village, under name of Hackettstown Aqueduct Co. Engr., A. R. Day.

Water Supply.—Mountain stream, by gravity.

Reservoir.—Cap., not given; area, ¾ acres; about 100 ft. above village.

Filter.—At reservoir; sand, gravel, charcoal.

Distribution.—*Mains*, c. i., 10 miles. *Services*, galv. i. *Taps* (in '87), 350. *Meters*, none. *Hydrants*, kind not given, 40.

Consumption, not given. *Pressure*, 40 lbs.

Financial.—Cost, $54,000. Bonded debt, $53,500. Int., 5, 6 and 7%. Sinking fund, $11,000. Ann. op. exp., withheld, est., $1,000. Ann. rev.: consumers, $5,000 city, none.

Management.—Prest., Wm. Drake. Secy. and Treas., W. S. Pettenhouse. Supt., Wm. Sidner.

HADDONFIELD, *Camden Co.* (Pop., 1,480; est., 2,500.) Not incorp. No sewers or electric lights.

History.—Built in 86-7 by Haddonfield Water Co. Engr. and Contr., Malcolm Peters, Philadelphia, Pa.

Water Supply.—Small spring-fed stream, pumping from impounding reservoir to stand-pipe. Stream has dy. flow of 400,000 galls.

Impounding Reservoir.—Cap., about 2,000,000 galls.; area, 1 acre; 25 ft. below, 4,000 ft. from base of, stand-pipe. Dam of earth, 100 ft. long, 16 ft. high. Built prior to '10 to give power for grist mill; mill not in operation since '69.

Pumping Machinery.—Dy cap., 700,000 galls; Worthington.

Stand-Pipe.—Cap., 145,000 galls.; 15x110 ft.; from Cunningham Iron Works, E. Boston, Mass.

Distribution.—*Mains*, 6 to 3-in. kal. i., 11½ miles; from National Tube Works Co., McKeesport, Pa. *Services*, galv. i. *Taps*, 160. *Meters*, Worthington, Thompson. 22. *Hydrants*, Chapman, 20. *Valves*, Chapman, Ludlow.

Consumption, 20,000 galls. *Pressure*, 40 lbs.

Financial.—Cost, $40,000 Cap. stock, $40,000. Ann. op. exp., $1,100. Ann rev.: consumers, $1,800; city, $500. Hydrant rental, $25 for first 20, $30 for additional.

Management.—Prest., Wm. H. Snowden. Secy., J. Standiy Simms. Treas., C. H. Hillman. Supt., D. G. Barnard.

HARRISON, *Hudson Co.* (Pop., est., 8,000.) P. O. on Passaic River, opposite Newark. Has manufactories.

History.—Date built not given; distribution, only, owned by village.

Water Supply.—Jersey City water-works, meter-measure.

Distribution.—*Mains*, 4½ miles. *Hydrants*, 65.

Pressure, 65 lbs.

Financial.—No data. Est. cost, $35,000.

Management.—No data.

HOBOKEN, *Hudson Co.* (Pop., 30,999; est., 38,000. Est., pop. supplied, 75,000.) On Hudson river, opposite N. Y. City. Incorp. Has sewers and electric lights.

History.—First supplied in '55; in '82 a new system was put in, which is now owned by the Hackensack Water Co., reorganized, and supplies considerable terri-

tory in Hudson and Bergen Cos., north of Jersey City, from Hudson river west to and including Hackensack river valley. Besides Hoboken, water is furnished to West Hoboken, Union Town, Weehawken, Guttenberg, North Bergen, Ridgefield, Englewood and Hackensack. Des. Engrs., Jno. F. Ward, Jersey City, and Chas. B. Brush, Hoboken. Const. Engr., Chas. B. Brush. Contr., Jno. F. Ward, Jersey City. Sub-contrs., Myles Tierney, Jno. W. Rutherfoord, N. Y. City.

Water Supply.—Hackensack river, filtered, pumping to reservoirs and tanks.

Pumping Machinery.—Dy. cap., 16,000,000 galls., Worthington dup.

Filters.—National.

Reservoir.—Two; cap., 3,000,000 and 15,000,000 galls., respectively.

Tanks.—Three; cap., 150,000, 5,000 and 3,000 galls., respectively; largest 30 x 30 ft. Contrs. for reservoirs and tanks, Smith Bros. and Jno. McLaren.

Distribution.—*Mains*, c. i., 81 miles. *Services*, lead. Pipe and specials from Warren Foundry & Machine Co., Phillipsburgh, N. J. *Taps*, 6,250. *Meters*, 3,500. *Hydrants*, Chapman, Coffin, Mathews, Galvin, 575. *Valves*, kind, do.

Consumption, 4,500,000 galls. *Pressure:* Ordinary, 35 to 50 lbs, Fire, 50 to 75 lbs.

Financial.—Cost, $1,868,169. Cap. stock, $749,000: $375,000 preferred, $374,000, common. Bonded debt, $1,105,000. Int., 5%. Sinking fund, $21,716. Ann. op. exp. $58,127. Ann. rev.: consumers, $161,852; cities, $2,065. Hoboken free. Union Town, Weehawken and Guttenberg, $5; Ridgefield, Englewood and Hackensack, $15.

Management.—Prest., R. W. de Forest. Secy., Wm. Shippen. Treas., E. A. Stevens. Supt. Chas. B. Brush.

Reference.—Water tower at Weehawken described and illustrated in *Eng. News*, vol. XVI., p. 292.

JERSEY CITY, *Hudson* Co. (Pop., 120,722; est., 155,000.) On New York bay and Hudson river, opposite N. Y. City. Av. level above high tide for mile back from river is 8 ft., then ground rises abruptly to ridge running north and south, 130 ft. above high tide, then descends to near tide level on west side. Has extensive commerce and manufactories, and some of largest grain elevators and sugar refineries in world. Laid out in '04 as Paulus Hook, incorp. as City of Jersey in '20 and as Jersey City in '38. Has sewers and electric lights.

History.—Built in '52 by city. Engr., Wm. Whitwell. Hoboken was included in this system until about '82, and water is now furnished to Bayonne City, Kearney township, and Harrison. Contrs for large part distribution, including both w. i. and cem. and c. i. pipe, Am. W. Wks. & Gas Pipe Co., now Ferris & Halladay, Jersey City.

Water Supply.—Passaic river, pumping to reservoir. Water taken from river at Belleville, about 8 miles from city, pumped to receiving reservoir on ridge near river, conveyed thence in pipes across Newark meadows to distributing reservoirs on Bergen hill, in city.

Intake Pipe.—Was built of brick to edge of river, then wooden box extended into channel, with gate at outer end.

Pumping Machinery.—Dy. cap., 24,000,000 galls.; 19,000,000 of Worthington; also Cornish and Galloway. First engine was Cornish beam, with 80-in. steam cylinder, 34¾-in. pump plunger, 132-in. stroke. Ram of this engine was so great that it nearly started every joint in force-main, and in '59 stand-pipe was built to relieve this, increasing by 75% cap. of engine. In '61 and again in '70, similar Cornish engine was erected, and in '73 two 8,000,000 Worthington comp., dup. pumps were purchased for high service system by direct pumping at Bergen Hill; one of these was erected there in '77 and other at Belleville station in '73. The diam. of high-pressure cylinders was 29 in.; low-pressure, 50¼ ins.; pump-plungers, 28 ins.; length of stroke, 48 ins. In '73 temporary high service was supplied by Knowles & Sibley pump. In '71 Cornish engine No. 3 was badly wrecked by breaking of valve of water cylinder. The heavily loaded plunger crushed through guard blocks, destroying pump, and steam piston drove out cylinder head, piston passing clear through cylinder, rod being badly bent, and all contiguous valve gearing ruined.

Stand-Pipe.—That mentioned above was of plate-iron, ½ to 7-16 ins. thick, with base 6½ and top 4 ft. in diam., and 160 ft. high above ground. Being unprotected, this pipe fell Dec. 1, '69, and was repaired and re-erected. In '71 second stand-pipe was put up, 15 ft. from first; plate-iron, ¼ to 7-16 ins. thick, secured to base by flanges 6 ft. in diam. and 160 ft. high. Silicious composition was applied to old and new stand-pipes to prevent oxidation, and in '72 tower was built of brick and brownstone, 210 ft. high, enclosing both pipes.

Receiving Reservoir.—Cap., est., 10,000,000 gallons; at Belleville, in excavation and embankment, 299 x 368 ft., x 16 ft. deep. Inner slopes puddled, lined with brick on edge in cem., with backing of 18 ins. of rubble for 5 ft. below top. In '63 portion of lining, 125 ft. long, half as deep as slope, fell in, leaks having washed out 6 ins. of earth beneath, and reservoir having been suddenly lowered, owing to break in main crossing Hackensack river.

Conduit.—Length, 22,300 ft.; 17,500 ft. across meadows. First pipe was 20 ins. in diam., and across meadows was laid on plank, covered with muck, topped with gravel and sodded. It crossed river on piers at side of turnpike bridge, there being a 30-in. siphon at draw, resting on rollers, and having slip joints at ends. Pipe on bridge was enclosed in air-tight box to protect from freezing. In '62, conduit had settled in places on meadows, and in same year a 36-in. main was laid, the 2,000 ft. of slope from the receiving reservoir to meadows being of w. i. and cem., remainder c. i.

Across meadows, two rows of piles were driven, 3 ft. apart, to solid foundation, cut off 16 ft. below ground, cross-capped with 10x12-in. white pine timbers upon which was laid a brick pier, or wall, 12 x 44 ins., x 16-in. high. Pipe is placed on this wall and held in place by brick wall carried up side; crosses river beside old one, siphon resting on pile and timber foundation. Owing to settlement this siphon leaked, and in '74 it was removed. In '71 a 36-in. c. i. pipe, with flexible spherical joints, was laid on bed of river, just above old bridge crossing. In '73, second 36-in. main was laid, of w. i. and cem., foundation across meadows consisting of two rows of piles 2 ft. apart, capped transversely by timbers 12 ins. sq. and 6 ft. long, with 5 stringers, 8x10 ins., for every 6 ft., covered with plank flooring, the whole securely spiked. On this a brick cradle is built, in which rests the pipe imbedded in 1 in. of cem., with 8-in. arch turned over pipe, 1 in. of cem. intervening; whole covered with 12 ins. of earth, sodded. In '81 there were three 36-in. submerged pipes at river crossing, connected with the 36-in. mains.

Bergen Hill Storage Reservoir.—Cap., originally, 167,000,000 galls.; area, 27 acres; adjacent to distributing reservoir; earth embankments, supported on outside by masonry walls having base of 12 ft., outside batter, 1 in. in 1 ft., and rising by steps on the inside, the top being 3 ft. wide. Banks 27 ft. wide on top; inner slopes, 1½, and 2 to 1, and having a puddle heart-wall 8 ft. wide at base. Bottom puddled with clay and gravel; slopes lined with rubble masonry one-third of the way down from top, remainder unprotected. Reservoir nearly rectangular, divided in centre by masonry wall, with gates. Reservoir leaked badly in '80, water escaping under bank, along the natural surface. Built in '71-4.

Bergen Hill Distributing Reservoir.—Cap., 70,000,000 galls.; oval; area, 12 acres; av. depth, 15 ft.; flow-line, 125 ft above high tide. Inner slopes, lined with brick, with course of stone near flow-line. Bottom puddled with clay and gravel

Distribution.—*Mains*, c. i., 178 miles. *Services*, lead. *Taps*, 20,456. *Meters*, 240; first used here in '62. *Hydrants*, Mathews, McLean, Galvin, 1,738. *Pressure recording gauge*, Edson.

Consumption, 19,300,000 galls. *Pressure:* Ordinary, 15 to 60 lbs. Fire, 20 to 70 lbs.

Financial.—(In '87.) Cost, $4,950,000. Debt, $4,838,000. Int., not given. Ann. op. exp., $539,170. Ann. rev.: consumers, $514,428.

Management.—Chf. Engr., W. W. Ruggles.

Reference.—Further details given in *Eng. News*, vol. VIII., p. 226.

KEARNEY, *Hudson Co.* (Pop., 777; est., 9,000.) Near Jersey City.

History.—Built in '87 by township.

Water Supply.—Jersey City water-works, by gravity from receiving reservoir at Belleville.

Distribution.—*Mains*, c. i., 13 miles. *Services*, lead. *Taps*, 230. *Meters*, 70. *Hydrants*, Ludlow, Galvin, 94. *Gates*, kind, do.

Financial.—Cost, $60,000. Ann. op. exp., not given, but 9 cents per 1,000 galls. is paid for water. Ann. rev.: consumers, withheld, est., $5,000.

Management.—Supt., W. M. Green. Report made by V. G. Hard.

LAKEWOOD, *Ocean Co.* (Pop., est., 1,000.) Winter resort for invalids, 22 miles from Long Branch, on South branch of Metedeconk river. Not incorp. Has sewers and electric lights.

History.—Built in '86 by Lakewood Water Co. Engrs. and Contrs., Ferris & Halladay, Jersey City.

Water Supply.—South branch of Metedeconk river, filtered, pumping to standpipe.

Filters.—Dy. cap., 650,000 galls.; Hyatt; erected in Sept., '89.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Worthington.

Stand-Pipe.—Cap., 117,500 galls.; 20 x 50 ft.; from Ferris & Halladay, Jersey City.

Distribution.—*Mains*, c. i., 2.6 miles. *Services*, not given. *Taps*, 60. *Meters*, none. *Hydrants*, Ludlow, 22. *Valves*, Ludlow.

Consumption, 90,000 galls. *Pressure:* Ordinary, 45 lbs. Fire, 140 lbs.

Financial.—Withheld. *Est.:* Cost, $30,000. Ann. op. exp., $900. Ann. rev.: consumers, $2,000.

Management.—Prest., Isaac A. Van Hise. Secy. and Treas., Saml. D. Davis. Supt., Michael McGrovy.

LAMBERTVILLE, *Hunterdon Co.* (Pop., 4,183; est., 5,000.) On Delaware river, 14 miles above Trenton. Engaged in manufacturing. No sewers or electric lights.

History.—Built in '78 by Lambertville Water Co., under 10-years franchise. Engr., Isaac S. Cassin, Philadelphia. Work done by Co.

Water Supply.—Swana creek, by gravity. Drainage area, about 1¼ sq. m., of trap formation.

Reservoirs.—Two, cap., 22,000,000 galls.

Distribution.—*Mains*, c. i., 4 miles. *Services*, not given. *Taps*, 185. *Meters*, 5. *Hydrants*, kind not given, 30.

Consumption, 500,000 galls. *Pressure*, 68 lbs.

Financial.—Cost, $40,000. Cap. stock, $40,000. No debt. Ann. op. exp., $800. Ann. rev: consumers (in '87), $1,600; city, $600. Hydrant rental, $25.

Management.—Prest., Chas. A. Skillman. Secy. and Treas., Wm. V. Cooley. Supt., Torkett Conyell.

Reference.—*Eng. News*, vol. VIII., p. 328; few items regarding first reservoir.

LAWRENCEVILLE SCHOOL, *Lawrenceville, Mercer Co.* (Pop., 200.) School was established in '09.

History.—Built in '84 by Trustees of school. Des. Engr., J. J. R. Croes, N. Y. City. Const. Engr., Frederick S. Odell, N. Y. City. Contrs., Norcross Bros., Worcester, Mass.

Water Supply.—Well, pumping to stand-pipe. Well 16 ft. in diam., 23 ft. deep; normal level of water, 3 ft. below top. For 6 ft. below surface it is through clay, for remaining depth, loose sandstone; lined with brick, domed, provided with manholes. Supply is supplemented by storing rain water.

Pumping Machinery.—Dy. cap., 350,000 galls.; Worthington. When well is full water flows to pump-well, otherwise it is drawn through suction pipe, 800 ft.

Stand-Pipe.—Cap., 50,000 galls.: 10 x 85 ft., plate-iron, with lapped joints, riveted and caulked. Vertical joints lapped 3½ ins. and double riveted for 25 ft. above bottom. Other joints, lapped 2 ins., single riveted. Plates, ¼, 3-16, ⅛ in. bottom, ¼ in. thick. On foundation of rubble masonry in cement, 17 ft. in diam., 8 ft. deep.

Distribution.—*Mains*, c. i., 0.9 miles. *Services*, lead. *Taps*, 16. *Meters*, none. *Hydrants*, Eddy, 6. *Valves*, Eddy.

Consumption, 7,500 galls. *Pressure*, 30 lbs.

Financial.—Cost, $13,500. No debt. Ann. op. exp., $100. No rev.

Management.—Prest., J. T. Nixon. Secy., Chas. E. Green. Supt., E. S. McIlvanie.

Reference.—Additional facts regarding this system are given in "The Water Supply, Drainage and Sewerage of the Lawrenceville School," illustrated. By F. S. Odell. Trans. Am. Soc. C. E., vol. XVI., pp. 66-78.

LITTLE YORK, *Hunterdon Co.* (Pop., not given).

History.—Built in '83 by [illegible]a Distilling Co. to supply distillery and village. In '68 distillery was abandoned. Unofficially reported that village has free use of water.

Water Supply.—Spring, by gravity. Spring 500 ft. from old distillery.

Distribution.—*Mains*, 4-in., lead, 500 ft. or more. *Families Supplied*, 20. No further data.

LONG BRANCH, *Monmouth Co.* (Pop., 3,833; est., 6,500.) Is 41 miles from N. Y. City; has some manufactories. Summer resort. Incorp. Has sewers and electric lights.

History.—Built in '77 by Long Branch Water Supply Co.; works for supplying Monmouth Beach were consolidated with these in Nov., '82. Engr., H. P. M. Birkinbine, deceased. Contr., Jesse W. Starr, Jr., Philadelphia.

Water Supply.—Brook and springs, filtered, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 5,000,000 galls.; Worthington.

Filters.—Dy. cap., 2,000,000 to 3,000,000 galls.; Hyatt; erected spring of '88.

Stand-Pipe.—Cap., 152,000 galls.; 18 x 80 ft.

Distribution.—*Mains*, c. i., 25 miles. *Services*, galv. i. *Taps*, 780. *Meters*, none. *Hydrants*, 112; old hydrants, made by J. B. Starr & Sons, Camden, being replaced by Mathews.

Consumption, 710,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 70 lbs.

Financial.—Cost, $350,000. Cap. stock, $250.000. Bonded debt. $100,000. Int., 5%. Ann. op. exp., withheld, est., $5.000. Ann. rev.: consumers, withheld, est., $23,000; city, $3,800, for all purposes.

Management.—Prest., Geo. F. Baker. Treas., E. A. Walton. Secy. and Supt., Whitney Conant.

NOTE.—For an extended description of the Hyatt Filter plant, see *Eng. News*, vol. XX, p. 280.

MERCHANTVILLE, *Camden Co.* (Pop., 439; est, 1,200.) Incorp. No sewers or electric lights.

History.—Built in '87-8 by Merchantville Water-Works Co. Engrs., Isaac S. Cassin and Howard Murphy, Philadelphia, Pa.

Water Supply.—Stream, fed by springs, pumping to stand-pipe. Dy. flow of stream, 400,000 galls.

Reservoir.—Cap., 810,000 galls ; 60 x 150 ft., x 10 ft. deep. Contr., Seymour L. Bartholomew, Asbury Park.

Pumping Machinery.—Dy. cap., 500,000 galls.; Gaskill dup.

Stand-Pipe.—Cap., 37,600 galls.; 8 x 100 ft.; from Chas. E. Tippett, Harrisburg, Pa.

Distribution.—*Mains*, c. i., 7 miles. *Services*, iron, lead. *Taps*, 180. *Meters*, none. *Hydrants*, Cassin, 28. *Valves*, kind, do.

Consumption, 26,354 galls. *Pressure:* Ordinary, 45 lbs. Fire, 125 lbs.

Financial.—Cost, $35,000. Cap. stock, $17.000. Bonded debt, $15,000. Int., 5%. Ann. op. exp., $1,957. Ann. rev.: consumers, $1,949; city, $729. Hydrant rental, $30.

Management.—Prest., Alex. G. Cattell. Secy. and Treas., E. S. Hall. Supt., Edward S. Thorpe.

MILLVILLE, *Cumberland Co.* (Pop., 7,660; est., 8,000.) On Maurice river, on level ground. Manufactures cotton, iron and glass. Settled in 1800; incorp. village in '66. No sewers. Has electric lights.

History.—Built in '78 by Millville Water Co. Engr., Emile Geyelin. Contrs., R. D. Wood & Co., Philadelphia, Pa.

Water Supply.—Maurice river, pumping from impounding reservoir to stand-pipe.

Dam and Reservoir.—Cap., not given; area, 1,100 acres. *Dam:* ½ mile long, 25 ft. high, 20 ft. wide at top, and 60 ft. at bottom.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; 1,250,000 Worthington water-power, of 10 in. bore, lifts water 128 ft.

Stand-Pipe.—Cap., 10,000 galls.; 12 x 130 ft.; of ⅝-in. plate-iron.

Distribution.—*Mains*, c. i., 8 miles. *Services*, lead. *Taps*, 540. *Meters*, 7. *Hydrants*, Mathews, 67. *Valves*, kind, do. *Pressure-recording-gauge*, Edson.

Consumption, 25.000 galls. *Pressure:* Ordinary, 45 lbs. Fire, 53 lbs.

Financial.—Cost, $70,000. Cap. stock, $24,900. No debt. Ann. op. exp., withheld, est., $1,500. Ann. rev.: consumers, withheld, est., $10,000; city, $2.460. Hydrant rental, about $35.

Management.—Prest., Geo. Wood. Secy.,'N. G. Livermore. Treas., Walter Wood. Supt., Reuben Meredith.

MONMOUTH BEACH, *Monmouth Co.* (Pop., not given.) See Long Branch.

MONTCLAIR, *Essex Co.* (Pop., 5.147; est., 7,500.) Is 5 miles from Newark and 14 from N. Y. City. Has some manufactories. Not incorp. No sewers or electric lights.

History.—Built in '87 by Montclair Water Co., under 10-years franchise. Engrs., Geo. W. Howell and Jas. Owen. Contrs., McNamee & Co.

Water Supply.—Wells, pumping to tank

Pumping Machinery.—Dy. cap., 1,500,000 galls.; two Worthington.

Tank.—Cap., 282,000 galls.; 40x30 ft.

Distribution.—*Mains*, c. i., 28 miles. *Services*, not given. *Taps*, 517. *Meters*, 27. *Hydrants*, Mathews, 238.

Consumption, 200,000 galls. *Pressure*, 75 to 120 lbs.

Financial.—Cost, $180,000. Cap. stock, $1,000,000. No debt. Ann. op. exp., withheld, est., $5,500. Ann. rev.: consumers, withheld, est., $17,000; city, about $6,000. Hydrant rental, $26.

Management.—Prest., Whiting G. Snow. Secy., Albert P. Fisher. Treas., Jno. R. Bartlett. Supt., Jas. Owens.

MOORESTOWN, *Burlington Co.* (Pop., est., 2,000.) Not incorp. No sewers. Electric lights put in in '89.

History.—Built in '87-8 by Moorestown Water Co., with W. W. Taylor, Charleston, W. Va., as Engr. and Contr. at first, and afterwards. Penn. Pipe Mfg. Co., Germantown Junction.

Water Supply.—Impounding reservoir filled by 5 small spring-fed streams, pumping to tank and direct; also connection of pump with Pennsauken creek, emergency supply. Water flows by gravity from reservoir to pump, about 1,500 ft.

Dam and Reservoir.—Cap., not given; area, about 1½ acres; depth at dam, about 8 ft. Dam of earth.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Blake dup.

Tank.—Cap., about 70,000 galls.; 23 x 85 ft. high. Of cedar, placed on circular brick tower 48 ft. high, tower having stone and cem. foundations, and tank being roofed. The tank is 2½ miles from, and its top is 150 ft. above reservoir.

Distribution.—*Mains*, w. i. and cem., about 7¼ miles; from Penn. Pipe Mfg. Co., Germantown Junction. *Taps*, 50. *Meters*, 1. *Hydrants*, 50.

Consumption, 18,000 galls. *Pressure:* Ordinary, 65 lbs. Fire, 100 lbs.

Financial.—Cost, $40,000. Cap. stock, $40,000, all paid up. No debt. Ann. op. exp., $1,000, not including taxes. Ann. rev.: consumers, $725; city, $1,000. Hydrant rental, $20 each.

Management.—Prest., N. Newlin Stokes. Secy. and Treas., Saml. K. Robbins. Engr., John A. Burton.

MORRISTOWN, *Morris Co.* (Pop., 5,418; est., 8,000.) On Whippany river, small tributary of Passaic, in hilly district, chiefly on sandy promontory, with steep slopes. In agricultural and mining district. Settled in 1725; incorp. in '65. No sewers. Has electric lights.

History.—Built in 1799 by The Proprietors of the Morris Aqueduct. Des. Engr., not known. For many years prior to '69 stock was held by one person, and no records of works kept.

Water Supply.—Springs, by gravity from impounding to distributing reservoir. In '65 pump was erected to take water from river in time of drought.

Impounding Reservoirs.—Combined cap., 19,400,000 galls. Three; last being built in '80, and having cap. of 16,000,000 galls. Engr. of last one, Geo. W. Howell. Other reservoirs have cap. of 1,400,000 and 2,000,000 galls., respectively. Water is taken from these reservoirs from near surface, dropped through fine wire screens, for aeration.

Conduits.—In '82, there were two 6-in. mains to distributing reservoir, one of c. i., other of w. i. and cem

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Worthington.

Distribution.—*Mains*, c. i., 28 miles. *Services*, c. i., galv. i., lead. *Taps* (in '87), 800. *Meters*, 340. *Hydrants*, kind not given, 100.

Consumption, 275,000 galls. *Pressure*, 30 to 40 lbs.

Financial.—(In '87.) Cost, $230,000. Cap. stock, $125,000. Bonded debt, $125,000. Int., 5 and 6%. Ann. op. exp., about $6,000. Ann. rev.: consumers, about $16,000; city, $1,800. Hydrant rental, $25.

Management.—Prest., H. C. Pitney. Secy. and Treas., Edw. Pierson. Supt., Wm. A. Dunn.

MOUNT HOLLY, *Burlington Co.* (Pop., 4,621; est., 5,000.) On Rancocas creek, on generally level ground, with hills near by. Engaged in manufacturing. Settled in 1680. Has sewers and electric lights.

History.—Built in '46 by Mount Holly Water Co.

Water Supply.—Rancocas creek, pumping to reservoir, and direct pumping.

Pumping Machinery.—Dy. cap., 500,000 galls.; Worthington; 500,000 comp., dup., 1,000,000 comp., cond., added in '89.

Force Main.—*Old:* no data. *New:* 4,700 ft. 12-in.; laid in '89; Contr., J. Irving Hillpot.

Reservoir.—Cap., 600,000 galls.; in excavation and embankment, 100 x 50 ft., x 15 ft. deep, with partition wall.

Distribution.—*Mains*, c. i., 8 miles. *Services*, c. i. *Taps*, 500. *Meters*, 3. *Hydrants*, kind not given, 35.

Consumption, 200,000 galls. *Pressure:* Ordinary, 42 lbs. Fire, 55 lbs.

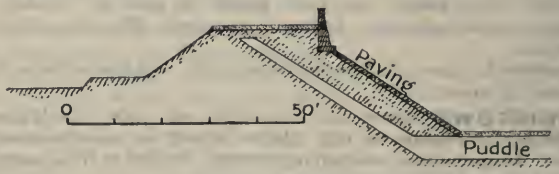
Financial.—Cost, $50.000. Cap. stock, $7,500. No debt. Ann. op. exp., $3,000. Ann. rev.: consumers, $5,300; city, 265. Hydrant rental, $5.

Management.—Prest., M. G. Pancoast. Treas.. B. Lewis. Secy. and Supt., H. C. Risdon.

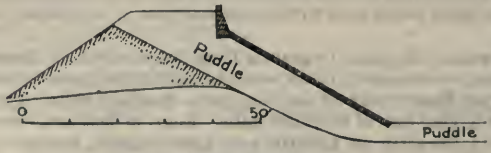
NEWARK, *Essex Co.* (Pop., 136,508; est., 160,000.) On west bank of Passaic river, 9 miles from N. Y. City. Nearly ¾ of territory comprised within city limits is less than 50 ft. above river. Remaining part rises gradually to elevation of about 225 ft. Extensively engaged in manufacturing. Incorp. Has sewers and electric lights.

History.—Built about 1800 by the Newark Aqueduct Co ; purchased by city in '60 for $150,000. New works built in '67. Engr., Geo. H. Bailey. Belleville is supplied, meter-measure, it owning part of plant in its streets; all data included below.

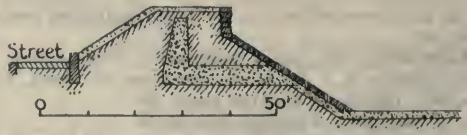
First supply from springs in red sandstone on hillside, about 80 ft. above village. Additional springs taken from time to time, and some wells sunk, both in rock and sand. When works were bought by city, in '60, Co. was supplying about 1,000,000 galls. daily through 17.51 miles of pipe, none of which was more than 10-in., while 11.6 miles were less than 4-in. Springs not yielding more than 700.000 galls. daily, supply was augmented by water from a brook, near reservoir, and by occasional draughts from Morris canal. In '62 and '65, new reservoirs were built with cap. of 12,000.000 galls. In '67 new works were built.



Receiving Reservoir.



Low-Service Reservoir.



High-Service Reservoir.

Sections through Embankments of Reservoirs, Jersey City, N. J.

Water Supply.—Passaic river, at Belleville, pumping to reservoir, with repumping for high service. Above Newark, river has drainge area of 981 sq. m., favorable to collection of pure water, but few miles above city river receives sewage from Paterson and Passaic, and tide carries sewage of Newark up river sometimes further polluting supply. At first, water filtered through sand and gravel of river banks to two basins, each 140 x 340 ft., and 9 ft. below low water in river, but yield soon became far less than consumption, more and more water being drawn directly from river.

It is stated that above was first attempt to use natural filter basins for purifying water supply of an American city.

In '77 ten 2-in. tubular wells were sunk in gravel plain near pumping station and river and yielded 700,000 galls. daily, for six months. Soon after 20 more wells, 3 ins. in diam., were driven, and in '80 an additional 40; water obtained of good quality, and being mixed in nearly equal proportions with the river water greatly improved the supply.

Pumping Machinery.—Dy. cap., 26,000,000 galls.; Worthington, 5,000,000, erected in '69, do. in '71, duplicate of first; 8,000,000 added in '75; do., since then. A 5,000,000 Worthington contracted for in '88. (Worthington people report pumps here with dy. cap. of 39,000,000 galls.)

Force Main.—Diam, 30 ins.; length, 6,000 ft.; discharges through bell-mouth in center of reservoir, 167½ ft. above high tide.

Reservoirs.- Cap., 44,000,000 galls. *Receiving:* cap., 14,000,000 galls., 297 x 404 ft., with 20 ft. of water; 165 ft. above high tide; in excavation and embankment. Inner slopes about 1½ to 1, with 12-in. paving in cem. See cut.

Low Service Distributing: cap., 21,000,000,; 454 ft. in diam., water 20 ft. deep; 114 ft. above tide; about 3 miles from receiving reservoir. See cut. Built on site of old quarry, bottom being filled to some depth with stone chips, covered with puddle. Latter gave way several times, emptying reservoir, and repairs being of no use all the loose material was finally removed to solid rock around base of bank, and trench filled with puddled clay. Built '71-3.

High Service: cap., 9,000,000 galls.; 254 x 302 ft., with 20 ft. water; 225 ft. above tide; in excavation and embankment. See cut.

Distribution.—*Mains*, c. i., 166.8 miles. *Services*, lead. *Taps*, 19,854. *Meters*, 501. *Hydrants*, Galvin, 1,381.

Consumption, 13,531,356 galls. *Pressure*, 23 lbs.

Financial.—Cost, $2,532,00(, exclusive of real estate, int. and maintenance. Bonded debt, about $3,500,000: $2,900,000 at 7; balance at 5 and 4%; sinking fund, $268,-869. Ann. op. exp., $114,760. Ann. rev.: consumers, $341,505; city, none.

Management.—Newark Aqueduct Board. Secy., Wm. E. Greathead, Supt., Geo. R. Gray.

NEW BRUNSWICK *Middlesex Co.* (Pop., 17,166; est., 20,000.) On Raritan river, 30 miles from N. Y. City. Crest of red shale bluff recedes at site of city, forming gently sloping amphitheater, about a mile in diam. Manufactures rubber goods, boots and shoes, buttons, wall paper, hosiery and machinery. Settled in 1784. Incorp. Has sewers and electric lights.

History.—Built in '65-8 by Co.; bought by city, Apr., '73. Des. Engr., Willard Smith. Const. Engr., Thos. N. Doughty.

Water Supply.—Lawrence brook, pumping from impounding to distributing reservoir. Drainage area, 43 sq. m.

Dam and Impounding Reservoir.—Cap., not given. *Old Dam:* stone, 15 ft. high, 184 ft long. Built in 1743, and a second wall built over 100 years ago. Feb. 25, '88, dam gave way owing to "inherent weakness," cutting off city water supply for a time. *New Dam:* built in '88. No further data.

Pumping Machinery.—Dy. cap., 7,900,000 galls.; 2,400,000 water-power, 3,500,000-gall. steam Worthington, 2,000,000 Carr. *Water-wheel:* 54-in. American turbine.

Distributing Reservoir.—Cap., 15,000,000 galls.; 130 ft. above pumps, in excavation and embankment, with two basins, each 300 ft. sq., x 15 ft. deep.

Distribution.—*Mains*, c. i., w i. and cem., 26 miles. *Services*, galv. i., lead. *Taps*, 1,900. *Meters*, 83. *Hydrants*, Ayers, Mathews, Ludlow, 181. *Close of* '73: Mains, 16¾ miles. Taps, 764. Meters, none. Hydrants, 104. *Close of* '80: Mains, 20 miles. Taps, 1,213. Meters, 54. Hydrants, 145.

Consumption, 1,153,363 galls. *Pressure*, 45 lbs.

Financial.—Cost, $493,586. Debt, $338,500. Int., 7%. Ann. op. exp., $13,001. Ann. rev: consumers, $42,246; city, $8,925. Hydrant rental, $50. Cos , close of '73, $344,931; do., '80, $432,893. Rev. in '73, $15,090; in '80, $42,754.

Management.—Six Comrs. Prest., Jno. Runyon. Secy., G. A. Applegate. Treas. and Supt., C. H. Cramer.

NEW JERSEY REFORM SCHOOL, *Jamesburg, Middlesex Co.* (Pop 320.) On 500 acres of land, which is generally level, and was established in '60. Has electric lights.

History.—Built prior to '83 by State. Engr., Jno. D. Bowne.

Water Supply.—Springs, pumping to stand-pipe; direct pumping can be used. Formerly water was pumped to two small reservoirs.

Pumping Machinery.—Dy. cap., not given; Knowles dup., with 16-in. steam, 8½-in. water cylinders and 12-in. stroke; and for direct pumping in case of fire, single direct-acting Knowles pump, with 14 x 12-in. steam, 8½-in. water cylinders.

Stand-Pipe.—Cap., 23,200 galls.; 8 x 75 ft.; from Chas. Tippett, Harrisburg, Pa.

Distribution.—*Mains*, w. i., about 2 miles. *Services*, w. i. *Taps*, 7. *Meters*, not given. *Hydrants*, Eddy, McLean, 7.

Consumption, 25,000 galls. *Pressure:* Ordinary, 35 lbs. Fire, 117 lbs.

Financial.—All data unknown, as works were built, and are operated in connection with other industries.

Management.—Supt, Jno. D. Bowne.

NUTLEY, *Essex Co.* (Pop., est., 1,600.) Is 2½ miles from Passaic, in farming section.

NOTE.—In '89 500,000 Worthington water-power pump was placed here. Ferris & Halladay, Jersey City, unofficially reported as Contrs., with works nearly finished latter part of '89. Address Jas. R. Hay.

OCEAN GROVE, *Monmouth Co.* (Pop., est., winter, 1,000; summer, 16,000.) Seaside summer resort. Incorp. Has sewers and electric lights.

History.—Built in '84 by Ocean Grove Association.

Water Supply.—Fifteen artesian wells, av. depth, 450 ft., pumping to tank.

Pumping Machinery.—Dy. cap., 900,000 galls.; Giles & Garrison.

Tanks.—Cap., 215,000 galls.; 35x30 ft.; iron.

Distribution.—*Mains*, iron, 12.57 miles. *Services*, lead. *Taps*, 540. *Meters*, 3. *Hydrants*, kind not given, 27.

Consumption, 400,000 galls. *Pressure*, 16 lbs.

Financial.—Cost, est., $55,000. Further data cannot be separated from other financial statistics of Association.

Management.—Prest., E. H. Stokes. V. Prest., A. G. Ballard. Treas., D. H. Brown. Supt., L. Rynear.

ORANGE, *Essex Co.* (Pop., 13.207; est., 15,500.) Is 12 miles from N. Y. City, on rolling ground from 150 to 390 ft. above tide-level. Place of residence for N. Y. City business men. Incorp. city in '75. Has electric lights.

History.—Built in '83 by city. Engr., Wm. B. Rider, So. Norwalk, Conn. Plans were approved by Com., consisting of State Geologist Geo. H. Cook, Isaac S. Cassin, Philadelphia, Horatio Allen, deceased.

Water Supply.—West branch of Rahway river, by gravity from impounding reservoir. Drainage area, about 5 sq. m.

Dam and Reservoir.—Cap., 375,000,000 galls.; area, about 60 acres; about 350 ft. above, and 5 miles from, center of city. Dam of earth, 875 ft. long, 40 ft. high, with stone heart-wall. Contrs., Freel & McNamee, Brooklyn, N. Y.

Filter.—Sponge and charcoal, in gate house of dam.

Distribution.—(In '87.) *Mains*, c. i., 21 miles. *Services*, lead, galv. i. Pipe laid by F. C. O'Reilly, Orange. *Taps*, 1,300. *Meters*, not given. *Hydrants*, Cassin, Wood, Chapman, Galvin, 200. *Valves*, kind, do.

Consumption (in '87), 1,000,000 galls. *Pressure*, 70 lbs.

Financial.—(In '87.) Cost, $400,000. Bonded debt, $400,000. Int., 5%. Ann. op. exp., withheld, est., $2,500. Ann. rev.: consumers, $15,000.

Management.—Com. of three from City Council. Supt., Thos. Dowd.

NOTE.—Inquiries sent in '89 ignored.

PALMYRA, *Burlington Co.* See Riverton.

PASSAIC, *Passaic Co.* (Pop., 6,532; est., 10,000.) On Passaic river, 5 miles from Paterson and 11 miles from N. Y. City. River is dammed at this point, affording water-power used in manufacturing. Ground is level near river, but rises steeply from plain more than 100 ft. Settled in 1680; rapid increase of population was caused in '72 by incorporation of Dundee Water-Power & Land Co. Incorp. No sewers. Has electric lights.

History.—Built in '72 by Acquackononk Water Co. Engr., Gen. Thos. D. Hoxsey.

Water Supply.—Vreeland lake, by gravity, supplemented by Passaic river, pumping to reservoir. Lake formed by damming Weasel brook.

Dam and Vreeland Lake.—Cap., not given. Dam 40 ft. long, 12 ft. high; one mile from village.

Pumping Machinery.—Dy. cap., 2,500,000 galls.; 500,000 Carr water-power, 2,000,000 Worthington comp. *Boilers:* Sullivan.

Reservoir.—Cap., 1,000,000 galls.; 125 ft. above river; one mile from lake.

Distribution.—*Mains*, w. i. and cem., 12 miles. *Services*, lead. *Taps*, 450. *Meters*, none. *Hydrants*, Mathews, Brown, 110.

Consumption, about 500,000 galls. *Pressure*, 35 lbs.

Financial.—Cost, about $155,000. Cap. stock, $43,000. Bonded debt, $75,000. Int., 7%. Ann. op. exp., $5,600. Ann. rev.: consumers, withheld, est., $12,000; city, $4,800. Hydrant rental, $45: 10-years contract.

Management.—Prest., G. A. Hobart. Secy., E. T. Bell. Treas., Jno. J. Brown. Supt., Washington Paulison.

PATERSON, *Passaic Co.* (Pop., 51,031; est., 65,000.) On Passaic river, 16 miles from N. Y. City, at point where river breaks through Watchung or Orange mountain, and falls 80 ft. Water-power afforded by this fall, with drainage area above 855 sq. m., was purchased in 1791 by "Society for the Encouragement of Useful Manufactures," and as late as '81 was still controlled by them. Water is directed from river for manufacturing purposes to canal by dam just above falls. City has large silk, iron, locomotive and other manufactories. Incorp. Has sewers and electric lights.

History.—Built in '56 by Passaic Water Co.

Water Supply.—Passaic river, pumping to reservoirs. First supply was taken between "Society's" dam and falls by water-power pump. Later, supply became insufficient, and small stone dam was built just above falls, forming small storage reservoir.

Pumping Machinery.—Dy. cap., 18,000,000 galls.; water-power and 3,000,000 Worthington high-pressure pumps, placed in '78. First water-power pumps were replaced by three horizontal pumps, with original combined dy. cap. of 16,000,000 galls.

Reservoirs.—Cap., 50,000,000 galls. Four, on different levels.

Distribution.—*Mains*, c. i., w. i. and cem., 80 miles; partly from Ferris & Halladay, Jersey City; 20 miles laid by Inman Bros., N. Y. City. *Services*, lead and galv. i. *Taps*, 5,900. *Meters*, 1. *Hydrants*, Watson Machine Co.'s, of Paterson, 767. *Valves*, kind, do.

Consumption, 9,000,000 galls. *Pressure*, 30 lbs.

Financial.—Cost, withheld, est., $1,500,000. Cap. stock, $425,000. Bonded debt, $1,100,000. Int., not given. Ann. op. exp., withheld, est., $25,000. Ann. rev.: consumers, withheld, est., $140,000; city, $28,379. Hydrant rental, $37.

Management.—Prest., G. A. Hobart. V.-Prest. and Supt., Wm. Ryle. Treas., Jno. J. Brown.

PENNINGTON, *Mercer Co.* (Pop., est., 700.) Not incorp. No sewers or electric lights.

History.—Built in '86-8, and put in operation in '87, by Pennington Spring Water Co., under perpetual franchise. Engr. and Contr., D. A. Clarkson, Pennington.

Water Supply.—Spring, by gravity.

Reservoir.—Cap., 600,000 galls.; 110 x 75 ft., x 20 ft. deep; oval clay banks; 50 ft. above highest part of town, about 2½ miles distant.

Supply Main.—Iron, 4-in., about 2½ miles long.

Distribution.—*Mains*, c. i., 4 miles. *Services*, galv. i. Pipe from R. D. Wood & Co., Philadelphia, Pa. *Taps*, 75. *Meters*, 1. *Hydrants*, none. *Valves*, Eddy.

Consumption, 15,000 galls. *Pressure*, 20 to 30 lbs.

Financial.—Cost, $9,000. Cap. stock, $10,000. No debt. Ann. op. exp., $25. Ann. rev.: withheld, est., $1,500; sufficient to pay 6% dividend on stock, besides op. exp. and construction.

Management.—Prest., D. A. Clarkson. Secy., Jno. J. Muirkheid. Supt., J. S. Bend.

PERTH AMBOY, *Middlesex Co.* (Pop., 4,808; est., 6500.) At mouth of Raritan river, on Raritan bay, on level ground. Engaged in ship-building and manufacturing fire brick and terra cotta. Incorp. Has sewers and electric lights.

History. Built in '82 by private Co., name not given. Contrs., Inman Bros., N. Y. City.

Water Supply.—Springs and surface water, pumping from impounding reservoir to stand-pipe.

Reservoir.—Cap., 20,000,000 galls.; in ravine, 1¼ miles from town.

Pumping Machinery.—Dy. cap., 3,000,000 galls; two 1,500,000 Blake; two non-cond., used in case of fire, and dup., cond. *Boilers:* Babcock & Wilcox.

Stand-Pipe.—Cap., 167,000 galls.; plate-iron, 20 x 71 ft.

Distribution.—*Mains*, c. i., 6.7 miles. *Services*, w. i., lead. *Taps* (in '87), 238. *Meters*, 48. *Hydrants*, Chapman, Ludlow, 62. *Valves*, kind, do.

Consumption, 350,000 galls. *Pressure:* Ordinary, 42 lbs. Fire, 100 lbs.

Financial.—Cost (in '87), $100,000. Cap. stock, $100,000. Bonded debt, $66,000. Int. 6%. Ann. op. exp., withheld, est., $2,000. Ann. rev.: consumers, withheld, est., $7,000; city, $3,100. Hydrant rental, $50.

Management.—Prest., Wm. Hall. Secy., C. C. Hommann. Treas., W. E. Stiger. Supt., Milton A. Brown.

PHILLIPSBURGH, *Warren Co.* (Pop., 7,181; est., 8,500.) On Delaware river, opposite Easton, Pa. Has manufactories. Incorp. Sewers built in '89. Has electric lights.

History.—Built in '87 by People's Water Co. Engr., J. Marshall Young. Contr., S. B. & C. W. Mutchler, Phillipsburgh. The Lehigh Water Co., of Easton, Pa., also supply part of town.

Water Supply.—Well, pumping to reservoir. It was proposed to take supply from Delaware river, but in digging pump-well ample supply of fine water was obtained.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; Gordon & Maxwell pump, also an auxiliary 1,600,000 pump.

Reservoir.—Cap., 2,000,000 galls.; on side of hill, in excavation and embankment 100 x 140 ft. on bottom; 12 ft. of water. Banks 17 ft. high, 30 ft. wide on top. Inner slopes 3 to 1, covered with 1 ft. puddled clay, then 1 ft. concrete; outer, 4 to 1, down-hill side. Inner part of bank clay and stones, rammed and puddled; outer, rock and dirt, dumped, unrammed. Does not leak. Engr. and Contrs., see History. Cost, $14,000.

Distribution.—*Mains*, c. i., 10 miles. *Services*, w. i. Pipe and specials from Warren Foundry & Machine Co., Phillipsburgh. *Taps*, 425. *Meters*, 6. *Hydrants*, Ludlow, 66. *Valves*, Ludlow.

Consumption, 300,000 galls. *Pressure*, 105 lbs.

Financial.—Cost, $100,000. Debt, $20,000. Int., not given. Ann. op. exp., withheld, est., $1,750. Ann. rev.: consumers, withheld, est., $10,000; city, $1,650. Hydrant rental, $25.

Management.—Prest., Saml. Thomas. Secy., Jno. O. Carpenter. Treas., Jno. A. Bachman. Supt., Geo. G. Stryker.

PRINCETON, *Mercer Co.* (Pop., 3,209; est., 3,800.) On narrow ridge with nearly level crest. Settled early in the last century. Incorp. in '12. No sewers. Has electric lights.

History.—Built in '83 by Princeton Water Co. Des. Engr., J. J. R. Croes, N. Y. City. Const. Engr., H. W. B. Phinney, West Fall Brook, Cal.

Water Supply.—Ground water, from well in valley to east, pumping to elevated tank. Well 25 ft. in diam., 16 ft. deep, bricked; about 150 ft. below village, sunk through 6 ft. of alluvial deposit, and 10 ft. of saturated gravel to sandstone.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; 500,000 Worthen, do., Worthington.

Force Main.—C. i., 10-in., 6,000 ft. long.

Tank and Tower.—Cap., 141,000 galls., 20 x 60 ft.; plate-iron, on iron trestle 60 ft. high. Top 90 ft. above highest ground in village, and 260 ft. above water in well.

Trestle rests on four stone piers, 10 ft. sq. at bottom, 5 at top, 8 ft. deep, capped with stone 4 ft. sq. and 10 ins. thick, with two 1¼-in. bolts running through and fastening trestle to foundation. The 10-in. force main is carried up near center of structure, has an expansion joint about 20 ft. above ground, and is extended to within 15 ft. of top to ensure circulation. When pump is not working water is drawn off through a T branch in pipe, near bottom of stand-pipe, furnished with check-valve opening into pipe, which closes when pump is in operation. On top of structure is a meteorological observatory erected by Prof. W. Libbey, Jr., specially to obtain unobstructed wind observations. Des. Engr., Theo. Cooper, N. Y. City. Contrs., Tippett & Wood, Phillipsburgh.

Distribution.—*Mains*, c. i., 6 miles. *Services*, galv. i. Pipe and specials from Warren Foundry and Machine Co., Phillipsburgh, and J. J. Fisher, Allentown, Pa. *Taps*, 255. *Meters*, 245. *Hydrants*, Eddy, 50. *Valves*, Eddy.

Consumption, 60,000 galls. *Pressure:* Ordinary, av., 40 lbs. Fire, av., 60 lbs.

Financial.—Cost, $66,200. Cap. stock, $50,000. Bonded debt, $20,000. Int., 5%. Sinking fund, $2,000. Ann. op. exp., $3,500. Ann. rev.: consumers, $5,500; city, $1,200. Hydrant rental, $30.

Management.—Prest., Chas. E. Greene. Secy. and Treas., Prof. W. Libbey, Jr Supt., Jas. E. Burke.

Reference.—An illustration showing elevation and details of tank and tower, was given in *Eng. News*, vol. X., p. 579.

RAHWAY, *Union Co.* (Pop., 6,455; est., $7,000.) On Rahway river, at head of tide, 19 miles from N. Y. City. Has manufactories. Settled in 1720; incorp. a city in '58. Has sewers and electric lights.

History.—Built in '71-2 by city. Des. Engr., Geo. H. Bailey, Newark. Const. Engr., A. S. Bonny. Contrs., C. A. Miller, Jos. Clarkson, J. G. Hubbard.

History.—Rahway river, direct pumping.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two 1,500,000 Worthington.

Distribution.—*Mains*, 12 to 4-in. w. i. and cem., 13 miles. Contrs., Am. Water & Gas Pipe Co., now Ferris & Halladay, Jersey City. *Services*, lead, iron. *Taps*, 650. *Meters*, none. *Hydrants*, Mathews, 125. *Valves*, Whittier Machine Co.'s. *Pressure recording gauge*, Edson.

Consumption, 800,000 galls. *Pressure:* Ordinary, 55 lbs. Fire, 70 lbs.

Financial.—Cost, $185,000. Bonded debt, $185,000. Int., 7%. Ann. op. exp., $5,500. Ann. rev.: consumers and city, $10,900.

Management.—Five Comrs. Prest., D. W. C. Hough. Secy. and Supt., H. B. Bunn.

RARITAN *Somerset Co.* See Somerville.

RED BANK, *Monmouth Co.* (Pop., 2,684; est., 5,000.) On Shrewsbury river, at head of navigation, 26 miles from N. Y. City. Has canneries and carriage manufactories.

History.—Finished in spring of '85 by village. Engr., Chas. G. Darrach, Philadelphia, Pa. Contrs., Wm. Richardson and Wm. Farrar, Red Bank.

Water Supply.—Well, pumping to reservoir, and direct. Well, 15 ft. in diam., 66 ft. deep, lined with brick in Portland cem.; cap. 54 feet below surface, 250,000 to 275,000 galls.

Pumping Machinery.—Dy. cap., 1,200,000 galls., two Worthington, special vertical comp. Intermediate iron trestle between steam cradles and pumps, including long piston rods, was built and erected by Wharton R. R. Switch Co. This trestle is 41⅞ ft. deep.

Reservior.—Cap., 800,000 galls.; 169 ft. above bottom of well, 140 ft. above tide level, 120 ft. above main level of town.

Distribution.—(In '87.) *Mains*, c. i., 4 miles. *Services*, galv. i. *Taps*, 160. *Meters*, 47. *Hydrants*, kind not given, 49.

Consumption (In '87), 125,000 galls. *Pressure:* Ordinary, 45 lbs. Fire, 55 lbs.

Financial.—(In '87.) Cost, $60,000. Debt, $60,000. Int., 5%. Ann. op. exp., $3,000. Ann. rev.: consumers (in '85), $3,500.

Management.—Comrs. Jno. H. Cook.

Reference.—For illustrated description of well and pumping machinery, see *Eng. News*, vol. XIV., pp. 130-1.

NOTE.—Inquiries sent in '89 have not brought responses.

RIVERTON and PALMYRA, *Somerset and Burlington Cos., respectively.* (Pop., combined, est., 5,000.) Palmyra is 7 miles from Camden. Neither village incorp. Neither has sewers or electric lights.

History.—Built in '89 by Riverton & Palmyra Water Co.; put in operation in Aug. Engrs. and Contrs., American Pipe Mfg. Co., Germantown Junction.

Water Supply.—Infiltration well near Delaware river, pumping to tank.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Barr dup. *Boiler:* from Erie (Pa.) Mfg. Co.

Tank.—Cap., 70,000 galls.

Distribution.—*Mains*, w.i. and cem., 9 miles. *Services*, lead, galv. i. *Taps*, 45. *Meters*, none. *Hydrants*, Ludlow, 53. *Valves*, Ludlow.

Consumption, 25,000 galls. *Pressure*, 50 lbs.

Financial.—Cost, $45,000. Cap. stock, $50,000. Debt, none.

Management.—Prest., Ed. H. Ogden. Secy., Treas. and Supt., Howard Parry, Riverton. Date of report, Dec. 6, '89.

SALEM, *Salem Co.* (Pop., 5,056; est., 6,000.) On Salem river, 2½ miles from mouth of Delaware river, on flat, sandy ground. Has glass manufactories, and fruit and vegetable packing establishments. Settled in 1675; incorp. city in '58. Has sewers and electric lights.

History.—Built in '82 by city. Engr., Isaac S. Cassin, Philadelphia.

Water Supply.—Well and surface water, direct pumping from impounding reservoir on Laurel river. Stream has drainage area of 5 sq. m.

Dam and Reservoir.—Cap., 42,000,000 galls.; dam of earth, founded on solid rock, 12 ft. below natural surface; 280 ft. long, 15 ft. wide on top; inner slope, 3 to 1, outer, 2 to 1. Waste water is carried under bank by 6-ft. conduit.

Conduit to pump-well: 12-in. c. i., 4 miles long.

Pumping Machinery.— Dy. cap., 1,000,000 galls.; Holly.

Distribution.—*Mains,* c. i., 9¾ miles. *Services,* galv. i. *Taps,* 418. *Meters,* none. *Hydrants,* Cassin, 66. *Valves,* Cassin,

Consumption, 300,000 galls. *Pressure:* Ordinary, 30 lbs. Fire, 110 lbs.

Financial.—Cost (in '87), $80.000. Debt, $75,000. Int., 5%. Ann. op. exp., including construction, $7,216. Ann. rev.: consumers, $4,570; city, $3,300. Hydrant rental, $50.

Management.—Supt., J. C. Hornblower.

SEABRIGHT, *Monmouth Co.* (Pop., est., 1,000 in winter and 3,000 in summer.) On Atlantic Ocean, 5 miles from Long Branch, and 26 from N. Y. City. Summer resort, and has fishing interests. Incorp. a borough. Has private sewers and electric lights.

History.—Built in '87 by Seabright Water Supply Co., under direction of C. H. Dederer; no general contractor. Formerly and still partially supplied by Long Branch Water Supply Co.

Water Supply.—Nine 3-in. artesian wells, pumping to stand-pipe. Six of wells are 125; three, 258 ft. deep. Six were put down by Kissner & Bennett, Ocean Grove. See History.

Pumping Machinery.—Dy. cap.. 1,000,000 galls.; two Hall. *Boilers:* two 36 H. P.

Stand-Pipe.—Cap., 67,680 galls.; 12x80 ft.; from Cunningham Iron Works Boston.

Distribution.—*Mains,* c. i., 2 miles. *Services,* galv. i. *Taps,* 40. *Meters* and *Hydrants,* none.

Consumption, 100,000 galls. *Pressure,* not given.

Financial.—Cost, $18,000. Cap. stock, $25,000. No debt. Ann. op. exp., $1,000. Ann. rev.: consumers, $1,200; city, none.

Management.—Prest., J. R. Minugh. Secy., Geo. Elliott. Treas. and Supt., Mifflin Paul.

SHORT HILLS, *Essex Co.* (Pop., est., 400.) Not incorp. Has sewers. No electric lights.

History.—Built in '80 by Stewart Hartshorn.

Water Supply.—Springs, pumping to reservoir.

Pumping Machinery.—Dy. cap., 50,000 galls.; Worthington.

Reservoir.—Cap., 4,000,000 galls.

Distribution.—*Mains,* c. i., 5 miles. *Services,* c. i., w. i. *Taps,* 65. *Meters,* Crown, 10. *Hydrants,* 2.

Consumption, 40,000 galls. *Pressure,* not given.

Financial.—Cost, $72,000. Debt, none. Ann. op. exp., $1,700. Ann. rev.: consumers, $850; city, not given. Hydrant rental, not given.

Management.—Owner, Stewart Hartshorn. Secy. and Treas., Geo. E. Croscup.

SOMERVILLE and RARITAN, *Somerset Co.* (Pop.: Somerville, 3,105; est., 6,000. Raritan, 2,046, est., 6,000.) On Raritan river. Somerville settled about 1800. Have electric lights.

History.—Built in '82 by Somerville Water Co. Engr., Geo. H. Pierson.

Water Supply.—Raritan river, filtered, pumping to stand-pipe, and direct. River flows through red shale district, and water before filtering is much discolored, except in very dry weather, and contains sediment.

Filters.—Cap., 500,000 galls.; Hyatt; erected July, '85.

Pumping Machinery.—Dy. cap., 1,000,000 galls. ; two 500,000 Worthington; a steam and water-power. *Water-wheel:* 44-in. Leffel turbine, under 11 ft. head.

Stand-Pipe.—Cap., 88,000 galls.; 10x150 ft.

Distribution.—*Mains*, c. i., 8 miles; from Warren Foundry & Machine Co., Phillipsburgh. *Services*, lead. *Taps*, 400. *Meters*, 6. *Hydrants*, Eddy 1. *Valves*, Eddy.

Consumption, 400,000 galls. *Pressure:* Ordinary, 50 lbs. Fire, 60 lbs.

Financial.—Cost, $64,613. Cap. stock, $50,000. Debt, $2,300: $300 at 6, $2,000 at 5%. Ann. op. exp., $3,936. Ann. rev.: consumers, $7,034; cities, $1,148. Hydrant rental, $28.

Management.—Prest., Adolph Mack, Raritan. Secy., A. V. D. Honeyman. Treas., Hugh K. Gaston. Supt., J. Harper Smith, Raritan.

SUMMIT, *Union Co.* (Pop., est., 4,000.) Is 20 miles from N. Y. City. Has manufactories.

History.—Built latter part of '89 by Summit Water Co.; controlled by Commonwealth Water Co., Newark. Engr., Carrol Ph. Bassett, Newark. Labor done by Co.

Water Supply.—Wells in Blue Brook valley, east of Summit, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two 1,000,000 Worthington: one comp., cond., one dup.

Stand-Pipe.—Cap., 183,000 galls.; 25x50 ft.

Distribution.—*Mains*, 10 to 4-in. c. i., 7 miles; from Warren Foundry & Machine Co., Phillipsburgh. *Hydrants*, Mathews, 50. *Valves*, Eddy.

Pressure, 60 to 80 lbs.

Financial.—Est. cost (Sept., '89), $70,000. Cap. stock, $100,000.

Management.—(Of Commonwealth Water Co., Newark.) Prest., Franklin Murphy. Secy., Eugene Vanderpool. Treas., Fredk. Frelinghuysen. Date of latest report, Mar. 11, '90.

TRENTON, *Mercer Co.* (Pop. 29,910; est., 40,000. Est. pop. supplied, 55,000.) On Delaware river, at head of steam navigation, on undulating ground rising in some places 100 ft. above river. Assanpink creek flows through city. Manufactures and decorates pottery, also makes wire and wire rope, rubber goods, and has large rolling mill. Settled in 1700. Incorp. Has sewers and electric lights.

History.—Built for domestic supply by Co. in '83; purchased and rebuilt for general supply by city in '55. Supplies Milham. Chambersburg borough consolidated with Trenton in '88; latter assumed borough works, and $45,000 borough water bonds. Supply in '03 was furnished by Co. organized that year by Stephen Scales and chartered with a cap. stock of $1,200. Supply was from spring and was continued until '52 when Co. was authorized to pump water from Delaware river and build reservoirs. A 10-in. water-power pump was erected and a 1,415,000-gall. reservoir built 100 ft. above river. Co. had expended $88,000 on works in '55 when city bought most of stock, and introduced fire hydrants. In '56 additional reservoir was built. Engr. Chas. Potts. In '63 a steam pumping engine of 12-in. bore was built by Wm. Carr.

Water Supply.—Delaware river, pumping to reservoir.

Filter Basin.—At river; 60x100 ft.; tile bottom, 4 layers of gravel, one of sand on top.

Pumping Machinery.—Dy. cap., 10,000,000 galls.: 6,000,000 and 2,000,000 Worthington; 2,000,000 Wright. One Worthington is a water-power.

Reservoirs.—Cap., 20,000,000 galls.

Supply Mains.—*Old:* no data, *New:* 36-in.; laid in '89.

Distribution.—*Mains*, c. i., about 60 miles. *Services*, galv. i. *Taps*, about 9,500. *Meters*, 46. *Hydrants*, Detroit, 266.

Consumption, 3,000,000 galls. *Pressure*, 30 lbs.

Financial.—Cost, $530,384. Debt, $310,000: $260,000 at 6, $50,000 at 5%. Sinking fund, $226,875. Ann. op. exp., $16,980. Ann. rev.: consumers, $77,299.

Management.—Comrs. Prest., Robt. Atkin. Secy. and Treas., Chas. A. Reid. Supt., Jacob E. Carter.

UNION, *Union Co.* (Pop., 2,418.) See Hoboken.

VINELAND, *Cumberland Co.* (Pop., 2,519; est., 3,250.) In Landis township.

History.—Built in '86 by Chas. J. Keighley, after plans by himself.

Water Supply.—Driven wells, pumping to tank.

Pumping Machinery.—Dy. cap., 200,000 galls.; Holly-Gaskill

Tank.—Cap., 79,000 galls.; 36x15 ft.

Distribution.—(In '87.) *Mains*, c. i., 10 miles. *Services*, galv. i. Pipe and specials from R. D. Wood & Co., Philadelphia, Pa. *Taps*, 300. *Meters*, none. *Hydrants*, kind not given, 36.

Consumption (in '87), 175,000 galls. *Pressure:* Ordinary, 30 lbs. Fire, 45 lbs.

Financial.—(In '87.) Cost, $40,000. Debt, none. Ann. op. exp., small, being run in connection with owner's factory. Ann. rev., withheld, est., $7,000; city, about $1,000. Hydrant rental, $30.

Management.—Owner, Chas. J. Keighley.

NOTE.—No response to inquiries sent in '89.

WASHINGTON, *Warren Co.* (Pop., 2,142; est., 3,000.) Manufactures pianos, cabinet organs and shoes.

History.—Built in '82 by Washington Water Co. No general Contr.

Water Supply.—Small stream, by gravity.

Reservoir.—No data.

Distribution.—(In '87.) *Mains*, c. i., 5¾ miles. *Services*, iron. *Taps*, 150. *Meters*, not given. *Fire plugs*, 40.

Consumption, not given. *Pressure*, 85 lbs.

Financial.—(In '87.) Cost, $35,000. Cap. stock, $35,000. No debt. Ann. op. exp., withheld, est., $800. Ann. rev.: consumers, withheld, est., $1,000.

Management.—(In '87.) Prest., Z. W. Fitts. Treas., P. H. Hann. Supt. Danl. Vliet.

NOTE.—Inquiries sent in '89 have been ignored.

WEEHAWKEN, *Hudson Co.* (Pop., 1,102.) See Hoboken.

WENONAH, *Gloucester Co.* (Pop., est., 500.) No sewers or electric lights.

History.—Built in '85 by Wenonah Water Co. Engrs., and and Contrs., R. D. Wood & Co., Philadelphia, Pa.

Water Supply.—Spring, pumping to tank and direct.

Pumping Machinery.—Dy. cap., 300,000 galls.; Worthington water-power, with engine in rererve.

Tank.—Cap., 59,000 galls.; wood.

Distribution.—*Mains*, 6 to 3-in. c. i., 2 miles. *Taps*, 75. *Meters*, none. *Hydrants*, Mathews, 12. *Valves*, Eddy.

Consumption, 25,000 galls. *Pressure:* Ordinary, 42 lbs. Fire 90 lbs.

Financial.—Cost, $10,000. Cap. stock, $10,000. No debt. Ann. op. exp., $450. Ann. rev.: consumers, $850; city, $120. Hydrant rental, $10.

Management.—Prest., Stephen Greene, 27 S. 5th St., Philadelphia, Pa. Secy. and Treas., Edw. Farr. Supt., Blair Smith.

WEST HOBOKEN, *Hudson Co.* (Pop., 5,441.) See Hoboken.

WOODBURY, *Gloucester Co.* (Pop., 2,302; est., 4,200.) On Woodbury creek, 7 miles from Camden and 3 from Delaware river. Incorp. No sewers. Has electric lights.

History.—Built in '86 by village. Engrs., Isaac S. Cassin and Howard Murphy, Philadelphia, Pa.

Water Supply.—Head of Mantua creek, pumping from settling to distributing reservoir; direct pumping in case of fire.

Settling Reservoir.—No data.

Pumping Machinery.—Dy. cap., 1,500,000 galls; Gordon & Maxwell.

Force Main.—Diam., 12 ins.; length, 2½ miles; branches at reservoir, one branch going to each compartment.

Distributing Reservoir.—Cap., 1,250,000 galls.; in excavation and embankment, 120 ft. long, water 12 ft. deep; in two compartments, division made by brick wall, 6 ft. high, bottom 89½ ft. above highest point in city. Pumps, 2½ miles to south; city 2 miles to north. Banks of sand, without heart-wall; 14 ft. high, 15 ft wide on top. Inner slopes, 1½ to 1, paved with brick on edge in cem. Force main arranged to deliver to, and supply main to draw from either compartment, making 4 pipes passing through bank. Reservoir does not leak much. Engrs., Cassin & Murphy, Philadelphia. Contrs., Koon & Mooney.

Supply Main.—Diam., 12 ins., length, 2 miles.

Distribution.—*Mains*, c. i., 11¼ miles. *Services*, galv. i., lead. *Taps*, 400. *Meters*, 4. *Hydrants*, kind not given, 62.

Consumption, 200,000 galls. *Pressure*, 60 lbs.

Financial.—Cost, $72,000. Bonded debt, $70,000. Int., 4%. Sinking fund, $1,500. Ann. op. exp., $1,630. Ann. rev.: consumers, $3,262; city, none.

Management.—Water Com. Clerk, S. B. Burke. Supt., B. W. Cloud.

Water-Works Projected with Fair Prospects of Construction.

FREEHOLD, *Monmouth Co.* (Pop. 2,432; est., 3,000.) Has some manufactories and considerabe trade. Has electric lights.

Proposed Works.—In '89 town sunk experimental artesian wells and found that water could be obtained short distance below surface. Three wells are recommended, pumping to stand-pipe. Est. cost, $30,000 to $40,000. Chf. Town Comr., Jas. S. Yard. Latest report, Jan. 10, '90.

KEYPORT, *Monmouth Co.* (Pop., est., 3,000.) On Raritan Bay, 24 miles from N. Y. City. Has shipping trade.

Proposed Works.—Some talk of town building works, but nothing definite decided. Supply, none save artesian wells available. Pop. much scattered. Date of report, Mar. 15, '90.

PLAINFIELD, *Union Co.* (Pop., 3,125; est., 13,000.) Is 24 miles from N. Y. City. No sewers. Has electric lights.

Proposed Works.—Plainfield Water Supply Co. was granted franchise in fall of '89. Supply, from wells or Passaic river, pumping to stand-pipe or reservoir. About 20 miles mains. Labor to be done by Co. Engr for city, Rudolph Herring, N. Y. City. Mar. 20, '90, suitable supplies from wells had not been found. City Clerk, O. B. Leonard. Com., Henry B. Newhall, Eric N. Erickson.

SEA ISLE CITY, *Cape May Co.* (Pop., est., 350.) Summer resort, 65 miles from Philadelphia.

Proposed Works.—Latter part of '89 borough granted franchise to Co., of which Mr. J. Kelley is Prest. Unofficial report in summer of '89 stated that Consumers' Water & Sewerage Co. would bring water from Magnolia lake 2 miles distant. Clerk Com., R. H. Lee.

SOUTH ORANGE, *Essex Co.* (Pop., 2,178; est., 4,000.) Is 16 miles from N. Y. City, in farming section.

Proposed Works.—Unofficially reported in fall of '89 that Water Com. recommended issuing $5,000 of 4½% 5-year bonds for purchase of pipe and hydrants; also to contract with Orange for water. [Probably for fire protection only.]

WOODSTOWN, *Salem Co.* (Pop., est., 1,800.) On Salem Creek, 25 miles from Philadelphia, in agricultural region. Manufactures agricultural implements.

Proposed Works.—Oct. 1, '89, few individuals have been considering bringing water to village from springs two miles from village. No Co. has been formed.

Water-Works Projects Reported in '89 and '90, but Now Indefinite.

Chatham, Morris Co. *Collingwood*, Camden Co. *Madison*, Chatham Co. *Tom's River*, Ocean Co.

PENNSYLVANIA.

Water-Works Completed or in Process of Construction.

ADRIAN MINES, *De Lancey P. O., Jefferson Co.* (Pop., est., 1,300.) Not incorp. No sewers or electric lights.

History.—Built in '86 by Rochester & Pittsburg C. & I. Co. Engr., W. F. Arms, Punxsutawney.

Water Supply.—Artesian well, 300 ft. deep, pumping to tanks. Connection can be made with mill pond.

Pumping Machinery.—Dy. cap., not given, three No. 7 Cameron.

Tanks.—Cap., 3,700 galls.; four 800, one 500 galls.

Distribution.—*Mains*, 4-in. c. i., 3 miles; from Buffalo (N. Y.) C. I. Pipe Co. *Taps*, 18; supplies 200 houses and 450 coke ovens. *Hydrants*, 14.

Consumption, about 4,000 galls.

Financial.—Cost, $4,000. Ann. op. exp., $400. Ann. rev.: none.

Management.—Supt., J. H. Bell. Report by A. M. Armstrong.

ALLEGHENY, *Allegheny Co.* (Pop., 46,682; est., 80,000.) At junction of Allegheny and Ohio rivers, opposite Pittsburgh. Near rivers ground is quite level, but at ½ to 1½ miles back it rises abruptly to from 500 to 600 ft. above the rivers. Hillsides are cut by 5 or 6 ravines through which flow small streams. Incorp. Has sewers and electric lights.

History.—Built in '47 by city when pop. was about 18,000. Des. Engr., R. Moore.

Water Supply.—Allegheny river, pumping to reservoir.

Intakes.—Water is taken from river 1½ miles above its mouth through two c. i. pipes extending 500 ft. from shore into channel.

Pumping Machinery.—Dy. cap., 34,000,000 galls. Water first pumped by two lever engines, coupled together, with 22-in. steam cylinders, 12-in. pumps, all 96-in. stroke; cap., 1,500,000 galls. In '54 these were duplicated. In '74 Lowry pumping engine was added, having 44-in. horizontal cylinders, 168-in. stroke, and two vertical 36-in. plunger pumps, 132-in. stroke. Allis pump has since been added. Natural gas is used for fuel.

Reservoir.—Cap., as first built, 9,600,000 galls.; area, 1½ acres; 217 ft. above, 600 ft. from, pumps. In excavation and embankment, bottom covered with 18 ins. of puddle, on which a 2-in. brick pavement is laid in sand; slopes lined with 24 ins. and paved with 4 ins. of brick in cem. Divided in two parts by wall of stone masonry, having footing of concrete on puddle. It is said that there is now reservoir having cap. of 18,000,000 galls., and new reservoir has been projected.

Distribution.—*Mains*, c. i., 76 miles. *Services*, lead. Pipe and specials from National Foundry & Pipe Works, Scottdale. *Taps*, 16,000, *Meters*, not given. *Hydrants*, 1,100; from J. R. Hutchinson.

Consumption, 21,000,000 galls. *Pressure:* 15 to 130 lbs.

Financial.—Cost, $1,930,000. Bonded debt, $1,084,000. Int., 4 to 7%. Sinking fund, $140,000. Ann. op. exp., $112,000. Ann rev.: consumers, $230,000.

Management.—Com. of 7 from Select, and 9 from Common Council. Supt., Edward Armstrong.

NOTE.—Since '87 several plans for a new supply have been proposed, but no definite steps had been taken late in fall of '89.

ALLENTOWN, *Lehigh Co.* (Pop., 18,063; est., 25,000.) On high ground on west bank of Lehigh river, between Little Lehigh on north and Jordan creek on south. Streets leading up from rivers are all steep. Manufactures iron, wire, thread, silk, hosiery, shirts, shoes and furniture. Settled in 1762; incorp. a borough in '11, a city in '67. Has sewers and electric lights.

History.—Works now owned by city; built in '27 by Northampton Water Co., which was incorp. in '16, reorganized some years later as Allentown Water Co., purchased by borough in '65. In '33 property of Co. was valued at $18,000, and it was sold in '65 for $140,000.

Water Supply.—Springs, pumping to reservoir and stand-pipe. Originally water was brought from the springs through 2,300 ft. of 12-in. pipe to pump-well and lifted thence by water-power pumps; a timber dam across the Lehigh river, 6 ft. high, furnished power. New pumps were added in '88.

Pumping Machinery.—Dy. cap., 6,000,000 galls.; two Knowles.

Reservoirs.—Cap., 410,000 galls.; two, covered, one being 28.8 x 47.8 ft., x 13 ft. deep, other 32 x 95.6 ft., x 12 ft. deep.

Stand-Pipe.—Cap., 22,000 galls.; 7 x 76 ft.; from Tippett & Wood, Phillipsburgh, N. J.; erected in '88.

Distribution.—*Mains*, c. i., 30 miles. *Services*, c. i. *Taps*, about 4,000. *Meters*, 1. *Hydrants*, Cassin, Mathews, Tamaqua, 163.

Consumption, 2,400,000 galls. *Pressure*, 90 lbs.

Financial.—Cost, $275,235. Bonded debt, $110,200; $11,000 at 7, $69,200 at 5, $30,000 at 4%. Sinking fund, none. Ann. op. exp., $21,000, including interest. Ann. rev.: consumers, $30,000; city, none.

Management.—Four Comrs. Prest., S. S. Frederich. Supt., Saml S. Thompson.

ALTOONA, *Blair Co.* (Pop., 19,710; est., 30,000.) Is 1,600 ft. above sea, in long valley, longitudinal streets being nearly level, and cross streets rising steeply. Has railroad shops and several manufactories. Incorp. city in '68. Has sewers and electric lights.

History.—Built in '71 by city when pop. was about 11,000. Des. Engr., H. P. M. Birkinbine. Const. Engr., F. E. Lythe. Later extensions, including large storage reservoir, were made with Chas. W. Knight, Rome, N. Y., Des. Engr., and J. W. Ladoo, Engr.-in-charge.

Water Supply.—Surface water, by gravity from impounding and distributing reservoirs.

Reservoirs.—*Impounding:* cap., 60,000,000 galls.; formed by dam across stream. *Distributing:* cap., 3,000,000 galls. First reservoirs consisted of small impounding, 6 miles from city, 278 ft. above main street, and distributing reservoir, 200 ft. sq., 20 ft. deep, on hill south of city, and 150 ft. above main street.

Distribution.—*Mains*, c. i., 37⅞ miles. *Services*, galv. i. *Taps*, 5,355. *Meters* none. *Hydrants*, Mathews, 112. *Valves*, Eddy, W. S. Payne.

Consumption, 1,750,000 galls. *Pressure*, 50 lbs.

Financial.—Cost (in '87), $359,000. Bonded debt, about $337,000. Int., 4%. Ann. op. exp., $16,000. Ann. rev.: consumers, $35,569; city, $10,330, int. on bonds.

Management.—Three Comrs. Chn., T. H. Wiggins. Secy., C. A. Martin. Supt., S. A. Gailey.

APOLLO, *Armstrong Co.* (Pop., 1,156; est., 6,000.) Engaged in coal mining and iron industries.

History.—Built in '88 by Apollo Water Co. Contr., R. B. Thomas, Clarion, Pa.

Water Supply.—Kiskiminates river, pumping to tanks.

Pumping Machinery.—Dy. cap., not given; Keystone.

Tanks.—Four, cap. not given.

Distribution.—*Mains*, 8 to 4-in. iron, length not given; from National Foundry & Pipe Works, Scottdale, Pa. *Hydrants*, Ludlow, 20. *Valves*, Ludlow.

Financial.—Cost, $15,000. Cap. stock and bonds, $25,000. Ann. op. exp., withheld, est., $800. Ann. rev.: consumers, withheld, est., $1,000; city, $450. Hydrant rental, $25 each.

Management.—Supt., S. T. Stringfellow.

NOTE.—Inquiries sent in '89 have been ignored.

ARCHBALD, *Lackawanna Co.* (Pop., 3,049; est., 3,500.) On Laurel run, a mountain stream. No sewers or electric lights.

History.—Built in '75 by Archbald Water Co. Engr., O. L. Shepherd. Contrs., Curlin & Palmer, Scranton.

Water Supply.—Laurel run, by gravity from impounding reservoir.

Dam and Reservoir.—Cap., not given; 250 ft. above and 2,000 ft. from town. Dam of timber.

Supply Main.—First of 10-in. stoneware pipe, which gave way in a few years; in '83 1,500 ft. of it was replaced by c. i. pipe.

Distribution.—*Mains*, c. i., 4 miles. *Services*, galv. i. Pipe and specials from Leonard Bros., Scranton. *Taps*, 250. *Meters*, none. *Hydrants*, 6; from Bishop Bros.

Consumption, unknown. *Pressure*, 90 to 100 lbs.

Financial.—Cost, $22,000. Debt, $600. Int., 4%. Ann. op. exp., $300. Ann. rev.: consumers, $3,000; city, none. Hydrant rental, none.

Management.—Prest., J. J. Williams. Secy., Thos. Law. Treas., Jno. Carroll. Supt., Justus Bishop.

ASHLAND, *Schuylkill Co.* (Pop., 6,052; est., 7,300.) On Mahanoy creek, in mountainous country. Mining and manufacturing town. Settled in '48; incorp. a borough in '57. Has electric lights.

History.—Built in '76 by borough. Engr., Isaac S. Cassin, Philadelphia.

Water Supply.—Little Mahanoy creek, by gravity. Stream rises in Broad mountain, 1,400 ft. above sea.

Dam and Reservoirs.—Cap., 3,800,000 galls.: 2,000,000 and 1,800,000 respectively. First reservoir formed by dam across stream, of stone, backed with clay; about 5 miles from, 345 ft. above, town.

Supply Main.—C. i., 12-in., 27,400 ft. long.

Distribution.—(In '87.) *Mains*, c. i., 9.8 miles. *Services*, w. i., lead. *Taps*, 764. *Meters*, none. *Hydrants*, Cassin, 36. *Valves*, Cassin.

Consumption, 350,000 galls. *Pressure*, 120 lbs.

Financial.—(In '87.) Cost, $85,000. Bonded debt, $49,000. Int., 4 and 6%. Ann. op. exp., $1,200. Ann. rev.: consumers, $8,200.

Management.—(In '87.) Three Comrs. Chn., Jas. R. Dugan. Secy., Frank Rentz. Supt., Jos. Hardenock.

NOTE.—No reply to inquiries sent in '89.

ASHLEY, *Luzerne Co.* (Pop., 2 799.)

General Description.—Supplied by Crystal Spring Water Co., of Wilkes-Barre. There are 5 miles of pipe and 9 hydrants, the fire pressure being 110 lbs. See Wilkes-Barre.

ATHENS, *Bradford Co.* (Pop., 1,599; est., 3,000.) About one mile from Sayre, on plain between the Chemung and Susquehanna rivers, short distance above their junction. Has large iron bridge works. Settled in 1790. See Sayre.

AUSTIN, *Potter Co.* (Pop., est., 2,500.)

History.—Built in '88-9 by borough for fire protection. Contrs., Hardwicke & Ware, Buffalo, N. Y. **Water Supply.**—Springs, well and brooks, by pumping. **Pumping Machinery.**—Dy. cap., not given; Worthington. **Distribution.**—*Mains*, c. i. (Dec. 31, '90), 3 miles. *Hydrants*, 19. *Pressure*, no data. **Financial.**—Cost, $4,000. Debt, $300. Int., 6%. Ann. op. exp., not given, est., $250. **Management.**—Supt., Paul Costa.

BANGOR, *Northampton Co.* (Pop., 1,328; est., 3,100.) Has manufactories and slate quarries. Incorp. a borough. No sewers or electric lights.

History.—Built in '86 by Bangor Water Co., under perpetual franchise. Engr., J. Marshall Young, Easton.

Water Supply.—Spring, by gravity.

Reservoir.—Small.

Distribution.—*Mains*, 8 to 4-in. iron., 4¼ miles. *Services*, galv. i. *Taps*, 100. *Meters*, Crown. *Hydrants*, Ludlow, Tamaqua, 11. *Valves*, Ludlow.

Financial.—Cost, withheld, est., $35,000. Cap. stock, $20,000. Bonded debt, $15,000. Int., 6%. Ann. op. exp., withheld, est., $1,100. Ann. rev.: consumers, withheld, est., $3,000; city, about $275. Hydrant rental, $25.

Management.—Prest., J. Marshall Young, Easton. Secy., J. P. Cowell. Treas., F. L. Lesher. Supt, Chas. K. Stier.

BEAVER, *Beaver Co.* (Pop., est., 1,000.) On Ohio, near mouth of Beaver river, which furnishes water-power used in manufacturing.

History.—Built in '86 by village. Des. Engr., Jacob Schreuneller, Pittsburgh, Const. Engr., W. S. Watson, Beaver.

Water Supply.—Ohio river, filtered, pumping to reservoir.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Worthington and Blake dup.

Reservoirs.—Cap., about 300,000 galls.

Distribution.—(In '87.) *Mains*, c. i., 6 miles. *Services*, lead. *Taps*, withheld, est., 125. *Meters*, not given. *Hydrants*, kind not given, 70.

Consumption, about 300,000 galls. *Pressure*, not given.

Financial.—(In 8'7.) Cost $20,000. Debt, $6,000. Int., 5%. Ann. op. exp., $1,200. Ann. rev.: none.

Management.—(In '88.) Secy. of Council, E. N. Biggett. Supt., Geo. Joyce.

NOTE.—No reply to inquiries sent in '89.

BEAVER FALLS, *Beaver Co.* (Pop., 5,104; est., 10,000.) On Beaver river, 4 miles from its junction with the Ohio, and 31 from Pittsburgh. Manufactures glassware, and all kinds of hardware. Incorp. No sewers. Has electric lights.

History.—Built in '75 by Beaver Falls Water Co., when pop. was about 3,000. Des. Engrs., Jno. Reeves and H. Rice. Const. Engr., J. W. Ramsey.

Water Supply.—Beaver river, filtered through bank to well, thence by direct pumping and pumping to reservoir.

Pumping Machinery.—Dy. cap., 4,800,000 galls.; Wilson & Snyder; 3,500,000 Worthington. First pumps 1,500,000 Holly quadruplex, driven by water-power.

College Hill Reservoir.—Cap., 3,000,000 galls; 227 x 327 ft., 10 ft. water. Banks of clay, rolled hard, 12 ft. high, 8 ft. wide on top, 40 at bottom. Inner slopes and bottom paved with hard brick on edge. *Discharge-pipes:* two, 12-in. Reservoir does not leak. Built in '83. Contr., A. L. Funkhouser. Cost, $20,000.

Distribution.—*Mains*, 12 to 4-in. c. i., 15 miles. *Services*, lead. *Taps* (in '87), 1,421. *Meters*, 1. *Hydrants*, made by Ramsey & Corbus, 86 public and 25 private. *Valves*, Ludlow.

Consumption, 3,000,000 galls. *Pressure:* Ordinary, 73 lbs. Fire, 110 lbs.

Financial.—Cost, $180,000. Cap. stock, $160,000. No debt. Ann. op. exp., $6,500. Ann. rev.: consumers (in '87), $13,000; city, $2,150. Hydrant rental, $25.

Management.—Prest., Henry Rice, Beaver. Secy., Richard Rice, Beaver. Treas., Geo. Morrison. Supt., Jno. W. Ramsey.

BEDFORD, *Bedford Co.* (Pop., 2,011; est., 3,000.) On Raystown branch of Juniata river, on high ground between two ridges, one of which rises about 1,200 ft. above valley. Deposits of hematite and limestone close by. Has electric lights.

History.—Built in '72-6 by town under direction of water commission, there being no Engr. or Contr.

Water Supply.—Mountain springs, by gravity.

Reservoirs.—Cap., about 2,000,000 galls. *Old:* Originally three, largest having cap. of 600,000 galls., others much smaller; all in excavation and embankment, first two built having flow-line 120 ft. above town, and being puddled with clay, lined with brick on edge laid dry. In '85 one of these was abandoned. *New:* cap., 1,500,000 galls.; built in '85.

Distribution.—*Mains*, c. i., 8¼ miles. *Taps*, withheld, est., 330. *Meters*, not given. *Hydrants*, 14.

Consumption, not given. *Pressure*, 30 lbs.

Financial.—(In '87.) Cost, $35,000. Bonded debt, $23,500. Int., 6%. Ann. op. exp., $500. Ann. rev.: derived indirectly from taxation, for '88, $2,900.

Management.—Comrs. Town Clerk, Thos. Armstrong.

NOTE.—No report received in '89.

BELLEFONTE, *Centre Co.* (Pop., 3,026; est., 4,300.) In Spring township, on Spring creek, in very hilly limestone region. Manufactures lime, iron, nails, window glass. Settled in 1795; incorp. borough in '06. Has sewers and electric lights.

History.—Built in '07 by borough.

Water Supply.—Springs, pumping to reservoir.

Pumping Machinery.—Dy. cap., 1,440,000 galls.; Knowles. First pumps were driven by water-power, and were single-acting plunger.

Reservoir.—Cap., 290,000 galls.; 196 ft. above pumps.

Distribution.—*Mains*, c. i., 10 miles. *Services*, w. i., galv. l., lead. *Taps*, number said to be unknown, est., 500. *Meters*, none. *Hydrants*, made by W. P. Duncan & Co., Bellefonte, 40. *Valves*, kind, do.

Consumption, 500,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 90 lbs.

Financial.—Cost, $100,000. Debt, $118,955. Int., 5, 6 and 7%. Ann. op. exp., about $4,000. Ann. rev.: consumers, $8,000; city, none.

Management.—Borough Secy., C. F. Cook. Supt., Saml. D. Ryan.

BELLEVUE, *Lackawanna Co.* (P. O. Scranton.) See Minooka.

BERWICK, *Columbia Co.* (Pop., 2,095; est., 4,000.) In Briar township, on north branch of Susquehanna river. Manufactures cars, car-wheels and merchant iron. Settled in 1782; incorp. a borough in 1800. No sewers or electric lights.

History.—Built in '48 by Berwick Water Co.

Water Supply.—Spring on river's bank, pumping to reservoir.

Pumping Machinery.—Dy. cap., 240,000 galls.; made by Cruikshank, Mayer & Co., Danville. In '82, water-power pump was used in summer, and a steam engine in winter.

Reservoir and Stand-Pipe.—Is 102 ft. above pump, small, of stone masonry, having on its wall a stand-pipe 7 x 30 ft.

Distribution.—*Mains*, c. i., 9 miles. *Services*, w. i., lead *Taps*, 570. *Meters*, 1. *Hydrants*, Ludlow, 16. *Valves*. Ludlow.

Consumption, not given. *Pressure:* Ordinary, 27 lbs. Fire, 110 lbs.

Financial—Cost, $25,000. Cap. stock, $15,000. Bonded debt, $6,500. Int., 4%. Ann. op. exp., $1,500. Ann. rev.: consumers, $4,400; city, $160. Hydrant rental, $10.

Management.—Prest., C. H. Zehnder. Secy., G. L. Reagan. Treas., S. C. Jayne. Supt., Geo. Depuy.

BETHLEHEM, *Northampton Co.* (Pop., 5,193; est., 6,000.) On northeast fork of Lehigh river and Monocacy creek, on high and uneven land. Engaged in manufacturing, in center of coal and iron region. Settled in 1741; incorp. a borough in 1845. Partially sewered. Has electric lights.

History.—Believed to be second water-works system for public supply built in U. S., first works having been built in Boston in 1652. Bethlehem works were begun in 1754, by Hans Cristopher Christiansen, a millwright and native of Denmark, and "after severe struggles" were finished in 1761. Water was taken from spring issuing from magnesian limestone, near banks of Menagassi creek, as it was then called. It was conducted 350 ft. through underground conduit to cistern, or well, whence it was raised by a 5-in. lignum vitæ pump, through bored hemlock logs, to a wooden tank in village square, 70 ft. above pump. There being trouble from the bursting of wooden pipes, 1¼-in. pipes of sheet lead were tried. They were soldered along edges and bedded in a cement of pitch and brick dust, and laid in a gutter of brick. This expedient did not prove very successful.

In 1761, Christiansen, aided by John Arbo and Marshall, built larger works. An 18-in. undershot wheel, 2 ft. clear in buckets, was put in, driving three single-acting iron force pumps of 4-in. bore and 18-in. stroke. Pumps were made by a blacksmith,

and cost £8 12s. 4d. Records show that for his services Christiansen received 30 shillings "for ye water running." The force main was of gum wood, and the distributing pipes of pitch pine. Latter had to be renewed in 1769, and in 1786 lead pipes were substituted for the gum wood force main, and also for most of the distributing pipes, and cisterns were built at various points of village. Ever since this time a complete water-works system has been maintained. Last pitch pine pipes were abandoned in 1791.

Wooden tank in the "little square" was removed in 1803 and a stone tower built in Market street, about 15 ft. high, on which was a tank at an elevation of 112 ft. above the spring. In '13 iron pipes were introduced, having their joints packed with leather and clamped with iron. In '17 a reservoir, 70 x 10 ft., x 7 ft. deep, was built to meet demands for increased supply of water, and in '32 was supplemented by a second reservoir. In latter year triple pumps, having been in service for 70 years, were replaced by a double-acting pump of greater cap., with 5-in. bore and 3-ft. stroke, constructed by Rush & Muhlenberg, of Philadelphia. This pump is still in use. In '45 works came under control of Bethlehem Water Co. In '68 steam was substituted for water-power, and in '71 works were purchased by borough, from Bethlehem Water Co., for $20,300. In '72 a tank was erected to regulate pressure from direct pumping, and in '74 the wooden conduit from the spring to the pump-well was replaced by an 18-in. c. i. pipe, and a Cameron steam pumping engine put in. Later improvements described below.

It is interesting to know that early in their history these works filled those who saw them with astonishment and admiration, and on a register kept at that time are the names of many visitors of note, among whom were: in April 1768, Gov. Penn and Lady and Lord Chas. Montague; in 1774, Baron von Reefsdorf; in 1777, John Adams; in July, 1782, Gen. Geo. Washington, with his adjutants.

Water Supply.—Spring, direct pumping, with tanks as regulator of pressure.

Pumping Machinery.—Dy. cap., 3,450,000 galls.; direct-acting, 700,000 Cameron; 750,000 Worthington, added in '85; 2,000,000 Deane comp., non-cond., added in '89. For early pumps, see History.

Tanks.—*Old:* cap., 225,000 galls.; 40x24 ft., one 66x10 ft. *New:* cap., 743,000 galls.; 50x50 ft.; all from McKee & Wilson, Bethlehem.

Distribution.—(May 1, '89.) *Mains*, c. i., 8 miles. *Services*, lead. *Taps*, 800. *Meters*, none. *Hydrants*, Mathews, Tamaqua, 73. *Valves*, Ross, Eddy, Kennedy.

Consumption, 650,000 galls. *Pressure*, 82 lbs.

Financial.—Cost (Aug. 1, '89), about $90,000. Debt cannot be separated from general debt of borough. Int., 4%. Ann. op. exp., $4,100. Ann. rev.: consumers, $9,000; city, none.

Management.—Water Comrs. Chn., L. F. Giering. Supt., Chas. Bodder.

BIRDSBOROUGH, *Berks Co.* (Pop., 1,705; est., 2,800.) In hilly country, on Schuylkill river, 8 miles from Reading. Engaged in iron manufacturing. Settled in 1740; incorp. borough in '72.

History.—Built in '84 by the E. & G. Brooke Iron Co. Engr., Isaac S. Cassin, Philadelphia. Contrs., Denithorne Bros., Phœnixville.

Water Supply.—Indian run, fed by mountain springs, by gravity from impounding reservoir. Drainage area, 2½ sq. m.

Dam and Reservoir.—Cap., 25,000,000 galls.; 200 ft. above town. Dam of earth, 375 ft. long, 30 ft. high, with outer slopes, 1½ to 1, inner, 2½ to 1, latter having a 12-in. paving.

Supply Mains.—Diam., 12 and 10 ins.; length, 2½ miles.

Distribution.—*Mains*, 10 to 4-in. c. i., 5¼ miles. *Services*, galv. i., lead. Pipe and specials from Mellert Foundry & Machine Co., Reading. *Taps*, est., 300. *Meters*, none. *Hydrants*, Cassin, 36. *Valves*, Cassin.

Consumption, about 30,000 galls. *Pressure*, 80 lbs.

Financial.—Cost, $55,000. No stock, bonds or debt. Ann. op. exp., slight. No further data given, save that the Co. are the principal consumers.

Management.—Prest., Geo. Brooke. Treas., Geo. W. Harrison. Supt., Ward Harrison.

BLAIRSVILLE, *Indiana Co.* (Pop., 1,162; est., 1,600.) On Conemaugh river, at base of first bench of Allegheny mountains on west, in fine farming country. Settled early in last century; incorp. borough in '25. No sewers or electric lights.

History.—Built in '72 by borough. Engr. Robt. Neilson. Built by day labor, under supervision of borough.

Water Supply.—Conemaugh river, pumping to reservoir.

Pumping Machinery.—Dy. cap., 160,000 galls.; McKnight.

Reservoir.—Cap., 160,000 galls.; 60 ft. diam., 8 ft. deep; stone masonry, about 112 ft. above highest part of town.

Distribution.—*Mains*, c. i., 3½ miles. First pipe, wood wrapped with tarred i; gave continual trouble, and has been replaced with c. i. *Services*, lead. *Taps*, 340. *Meters*, none. *Hydrants*, Bailey, Mathews, 33.

Consumption, about 160,000 galls. *Pressure*, 30 to 50 lbs.

Financial.—Cost, $29 000. Bonded debt, $15,000. Int., 4%. Ann. op. exp., $1,200. Ann. rev.: consumers, $4,800.

Management.—Water Com. Supt., Jno. F. Kalback.

BLOOMSBURGH, *Columbia Co.* (Pop., 3,702; est., 5,000.) On north branch Susquehanna river. Engaged in iron manufacturing; in farming country. Not incorp. Has sewers. No electric lights.

History.—Built in '39 by Bloomsburgh Water Co. Engr., H. P. M. Birkinbine, deceased.

Water Supply.—Fishing creek, pumping to reservoir.

Pumping Machinery.—Dy. cap., 3,700,000 galls.: 1,200,000 Worthington, 2,500,000 Gaskill dup. *Boilers:* one horizontal, two vertical tubular.

Reservoir.—No data. A 3,500,000-gall reservoir is to be built in '89.

Distribution.—*Mains*, c. i., 10 miles. *Services*, galv. i. *Taps*, 500. *Meters*, 20. *Hydrants*, Birkinbine, Ludlow, 55. *Valves*, Cassin.

Consumption, 350,000 galls. *Pressure:* Ordinary, 75 lbs. Fire, 150 lbs.

Financial.—Cost, $70,000. Cap. stock, $90,000. Bonded debt (in '87), $8,000. Int., 5%. Ann. op. exp., $2,200. Ann. rev.: consumers, $5,500; city, $1,000. Hydrant rental, $6.

Management.—Prest., Jno. A. Funston. Secy. and Treas., Frank P. Billmyer. Supt., G. W. Welliver.

BOYERTOWN, *Berks Co.* (Pop., 1,099; est., 2,200.) Manufactures cigars; in rich agricultural and mining region.

History.—Built by Boyertown Water Co., date not given. Des Engr., Jno. Schaeffer. Const. Engr., and Contr., Jno. G. Schealer.

Water Supply.—Springs, direct pumping from reservoir.

Pumping Machinery.—No data.

Reservoir.—Cap., 25,000 galls.

Distribution.—(In '87.) *Mains*, 3 miles. *Hydrants*, 6, or more. No further data.

Financial.—Not given. *Est.:* cost, $20,000. Ann. op exp., $500. Ann. rev.: consumers, $2,000.

Management.—(In '88.) Prest., Geo. Mull. Secy., Fred. H. Stauffer. Treas., Thos. Shoner. Supt., Henry Douglas.

NOTE.—No replies received to inquiries sent in '89.

BRADFORD, *McKean Co.* (Pop., 9,197; est., 11,000.) At junction of two streams forming Tununguant creek, in valley and on slopes of hills, which rise 500 ft. above creek. City is 1,444 ft. above the sea. In center of rich oil region. Settled in '40; incorp. a city in '79. Has sewers and natural gas. No electric lights.

CITY WORKS.

History.—Built in '77 by Bradford Water Works Co., and bought by city in '81 for $19,400.

Water Supply.—Marilla and Gilbert brooks, by gravity from impounding reservoirs. Dy. cap. of supply, 36,000,000 galls. Direct pumping was originally used, there being two 9-in. Cameron and 750,000 Worthington pumps, but with the completion of the new Gilbert brook reservoir in '87, pumping station was abandoned. Under old system a 53,000-gall. wooden tank was used to equalize pressure.

Dams and Reservoirs.—Cap., 24,000,000 galls. *Gilbert Brook:* cap., 20,000,000 galls.; area, 10 acres. Dam of clay loam, with heart-wall; 650 ft. long, 18 ft. high. 13 ft. water; water 5 ft. from top; 5 ft. wide on top. Slopes, 2 to 1, unpaved. *Heart-wall:* puddled clay, 5 ft. wide at bottom, 2 at top, extends to top of dam. *Spillway:* 100 ft. from end of dam, not in rock, not lined with plank or masonry, free. *Discharge-pipes:* two, each 12-in.; waste and supply. Mar. 22, '88, a leak in bank, at or near spillway, caused 25 ft. of bank to wash away. Dam was repaired and strengthened. Built in '87. Des. Engr., J. A. Seymour. Contrs. J. and M. McMahon. Cost, $15,000.

Marilla Brook: cap., 4,000,000 galls.

Supply Main.—No data. Pipe connecting new reservoir with conduit, from Jackson & Woodin Mfg. Co., Berwick.

Dstribution.—*Mains*, c. i., w. i., 15.8 miles. *Services*, w. i. *Taps*, 1,200. *Meters*, 1. *Hydrants*, Ludlow, 57. *Gates*, Ludlow, 192.

Consumption, 1 500,000 galls. *Pressure*, 95 lbs.

Financial.—Cost, $115,000. Debt, $59,500. Int. 6%. Ann. op. exp., $3,000. Ann. rev.: consumers, $15,000; city, none. No allowance for hydrants.

Management.—Three Comrs. Prest., A. Newall. Secy. and Supt., C. J. Lane. Treas., E. A. Boyne.

YOUGHIOGHENY WATER-WORKS CO.'S PLANT.

General Description.—Built in '81 to supply coke ovens. Plant includes a 2,000,000-gall. reservoir, filled from stream by pumping through 2½ miles of pipe, there being two Cope & Maxwell pumps. In addition to the reservoir, a number of tanks give a storage capacity of over 1,000,000 galls. In '81, about 1,000 coke ovens were supplied. Further data given in *Eng. News*, vol. VIII., p. 513.

BRADDOCK, *Allegheny Co.* (Pop., 3,310; est., 12,000.) Center of Northern Pa. oil region. Has natural gas. Engaged in manufacturing. Incorp. borough. Has sewers and electric lights.

History.—Built in '84-5 by borough; put in operation July 19. Des. Engr., J. Schinneller, Pittsburgh. Const. Engr., Geo. L. Jones, Supt.

Water Supply.—Monongahela river, direct pumping.

Pumping Machinery.—Dy. cap., 2,500,000 galls.; two Worthington, 500,000 and 2,000,000. *Boilers:* from Rees & Thorn, Pittsburgh.

Distribution.—*Mains*, 16 to 3-in. c. i., 9 miles. *Services*, not given. Pipe and specials from McNeal Pipe & Foundry Co., Burlington, N. J.; trenching and pipe-laying done by Jas. McElhaney, Pittsburgh. *Taps*, 600. *Meters*, Crown, 14. *Hydrants*, Ludlow, 64. *Valves*, Ludlow.

Consumption, 1,000,000 galls. *Pressure:* Ordinary, 110 lbs. Fire, 125 lbs.

Financial.—Cost, $84,000. Debt, $65,000; $50,000 in bonds. Int., 4% Ann. op. exp., $3,500. Ann. rev.: consumers, $6,800; city, $2,544. Hydrant rental, $40.

Management.—Com. of 3. Supt., Geo. L. Jones.

BRIDGEPORT, *Montgomery Co.* (Pop., 1,802; est., 2,500.)

History.—Built in '89 or '89-90 by Bridgeport Water Co. Construction begun July 1, '89, and was to have been completed Oct. 1, '89. Unofficial reports stated that construction was in progress in Feb., '90. Engrs. and Contrs., Young Bros., Philadelphia.

Water Supply.—Schuylkill river, pumping to tank.

Pumping Machinery.—Barr pump. *Boilers:* from R. S. Newbold & Son, Norristown.

Distribution.—Pipe from Mellert Pipe Co., Reading.

Management.—Prest., F. H. Cheyney, 216 S. 3d St., Philadelphia. Date of report, Sept. 1, '89.

BRISTOL, *Bucks Co.* (Pop., 5,273; est., 7,000.) On Delaware river, on nearly level ground, 12 ft. above high water in river. Has yarn, hosiery, carpet and rolling mills, and a large foundry. Settled in 1684. No sewers. Has electric lights.

History.—Built in '74-5 by Bristol Water Co. Engr., Wm. E. Morris. Work done by day under direction of Co.

Water Supply.—Delaware river, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 2,500,000 galls.; Worthington; former reports give 2,000,000 comp., cond., two 500,000 high-pressure.

Stand Pipe.—Cap., 30,000 galls.; 6 x 140 ft.; from Henry G. Morris, Philadelphia.

Distribution.—*Mains*, c. i., 5½ miles. *Services*, lead. Pipe and specials from R. D. Wood & Co., Philadelphia, and A. H. McNeal & Co., Burlington, N. J. *Taps*, 637. *Meters*, 1. *Hydrants*, Mathews, 51. *Valves*, Eddy, Chapman.

Consumption, 600,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 100 lbs.

Financial.—Cost, $62,639. Cap. stock, $50,000. No debt. Ann. op. exp., $3,294. Ann. rev.: consumers, $10,058; city, $600. Hydrant rental, $12.

Management.—Prest., A. Swain. Secy., G. M. Dorrance. Treas., L. A. Hoguet. Supt., A. K. Joyce.

BROOKVILLE, *Jefferson Co.* (Pop., 2,136; est., 3,200.) On Red Bank creek, at junction of North Fork and Sandy Lick creeks, on three hills; surrounding country very rough. Engaged in lumber business. Settled in '30; incorp. borough in '31; village not incorp. No sewers or electric lights.

History.—Built in '83-5 by Brookville Water Co., under direction of W. D. J. Martin, labor being by day.

Water Supply.—North Fork creek, pumping to tanks. Drainage area, 30 sq. m.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Worthington.

Tanks.—Cap., 160,000 galls.; four; two of wood, set on framework 1 ft. above ground, 150 ft. above main part of town.

Distribution.—*Mains*, c. i., 6 miles. *Services*, w. i., lead. *Taps*, 160. *Meters* none. *Hydrants*, Hutchinson & Alexander, 26. *Valves*, kind, do.

Consumption, unknown. *Pressure*, 88 lbs.

Financial.—Cost, about $28,000. Cap. stock, $28,000. No debt. Ann. op. exp., $1,200. Ann. rev: consumers, $3,200; city, $492. Hydrant rental, $25 for 12, $16 for additional.

Management.—Prest., E. A. Litch. Secy. and Treas., B. M. Martin. Supt., W. R. Ramsey.

BUTLER, *Butler Co.* (Pop., 3,163; est., 6,000.) On Conoquenessing creek. Manufactures flour, plate glass, bottles, sash and doors and woolen goods, and is in agricultural, mining and natural gas district.

History.—Built in '78 by Butler Water Co. Des. Engr., W. E. Roe. Const. Engr. and Contr., Jas. McCullough, Jr.

Water Supply.—Conoquenessing creek, pumping to reservoir.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Keystone; from Epping, Carpenter & Co.

Reservoir.—Cap., 2,500,000 galls.

Distribution.—*Mains*, c. i., 17 miles. *Services*, lead. *Taps*, 400. *Meters*, none. *Hydrants*, Mathews, 50. *Valves*, Eddy.

Consumption (in '86), 216,000 galls. *Pressure*, 110 lbs.

Financial.—Cost, $119,000. Cap. stock, $75,000. Bonded debt, $30,000. Int., 6%. Ann. op. exp., withheld, est., $2,000. Ann. rev.: consumers, withheld, est., $12,000; city, $600. Hydrant rental, $12.

Management.—Prest., W. G. Brandon. Supt., Secy. and Treas., W. B. Meredith.

CANTON, *Bradford Co.* (Pop., 1,194; est., 1,400.) Has foundry and lumber mill. Incorp. Sewers projected. No electric lights.

History.—Built in '80 by Citizens' Water Co.

Water Supply.—Mountain brook and lake by gravity.

Dam and Impounding Reservoir.—No data.

Supply Main.—*Old:* no data. *New:* diam., 6 ins; length, 1½ miles; laid to lake in '89.

Distribution.—*Mains*, iron, 6 miles. *Services*, iron. *Taps*, about 200. *Meters*, none. *Hydrants*, kind not given, 14.

Consumption, unknown. *Pressure*, unknown, but heavy.

Financial.—Cost, not given, est., $50,000. Debt and int., not given. Ann. op. exp., $450. Ann. rev.: consumers, $1,800; city, $200 for all hydrants village cares to put in.

Management.—Prest., G. W. Maynard, Williamsport. Secy. and Treas., J. E. Cleveland. Supt., Geo. A. Guernsey.

CARBONDALE, *Lackawanna Co.* (Pop., 7,714; est., 10,000.) On Lackawanna river, at head of Lackawanna valley, in coal country. Settled in '28, incorp. city in '51. Has electric lights.

History.—Built in '68 by Crystal Springs Water Co.

Water Supply.—Springs, by gravity from two storage to distributing reservoirs.

Dams and Storage Reservoirs.—Cap., over 36,000,000 galls. *Storage No.* 1: cap. 29,400,000 galls.; area, 30 acres. Dam of earth, with timber bulkhead. Built by Delaware & Hudson Canal Co., on headwaters of Racket brook, about 2 miles from city. *Storage No.* 2: cap., 6,530,000 galls.; area, 10 acres. Dam of earth, with stone bulkhead.

Conduit.—Between storage reservoirs; 6,000 ft. of w. i. and cem. pipe.

Distributing Reservoir.—Cap., est., 6,000,000 galls.; area, 3 acres; depth, in embankment; 250 ft. above city.

Distribution.—*Mains*, c. i., w. i. and cem., 8 miles. *Services*, galv. *Taps*, 550. *Meters*, none. *Hydrants*, Philadelphia, 36. *Valves*, Ludlow.

Consumption, est. (in '87), 150,000 galls. *Pressure*, 90 lbs.

Financial.—(In '87.) Cost, cap. stock, $23,200. No debt. Ann. op. exp., Ann. rev: consumers, $7,500; city, $900. Hydrant rental, $25.

Management.—Prest., R. Mamille. Secy., L. Egerton. Supt., Wm. Tuts.

NOTE.—No replies received to inquiries sent in '89.

CARLISLE, *Cumberland Co.* (Pop., 6,209; est., 9,000.) In broken, rocky, region; has manufactories. Settled in 1750; incorp. borough in 1782, and had its charter amended in '14. Has electric lights.

History.—Built in '54 by Carlisle Gas & Water Co.; city holds some of the stock. Des. Engr., A. T. Smith.

Water Supply.—Conodoquinnet creek, pumping to reservoir.

Dam.—Across stream, three miles from town, furnishes power for pumping.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; first pump was made by F. Gardner, Carlisle, and was a 300,000 horizontal piston, driven by 6-ft. Leffel turbine, under 4½ ft. head. In '81-2 a Deane was added.

Reservoirs.—Cap., 2,500,000 galls.; two, in excavation, lined with brick masonry; each 124 x 132 ft., x 12 ft. deep; on hill midway between pumps and town, 125 ft. above pumps.

Distribution.—*Mains*, c. i., 12 miles. *Services*, lead. *Taps* (in '87), 550. *Meters*, none. *Hydrants* (in '87), 70; old ones made by Morris, Tasker & Co., new, Mathews.

Consumption (in '87), 750,000 galls. *Pressure*, not given.

Financial.—Cost, gas and water-works together (in '82), $99,661. Total cap. stock, $68,000. Debt, $9,000. Int., 5 and 6%. Ann. op. exp., water department (May 1, '88). $1,808. Ann. rev.: do., consumers, $7,200; city, $325.

Management.—(In '88.) Prest., Lemuel Todd. Supt. and Secy., Chas. E. Ramsey. Treas., Jno. B. Landis.

NOTE.—No replies received to inquiries sent in '89.

CATASAUQUA, *Lehigh Co.* (Pop., 3,065; est., 3,500.) On Lehigh river, in hilly country. Manufactures iron. Settled in '40.

History.—Built in '42 by Crane Iron Co.

Water Supply.—Lehigh river, pumping to reservoir and stand-pipe from feeder connecting river with Lehigh canal.

Pumping Machinery.—Cap., 800,000 galls.; two double-acting water-power, 6-in. bore, 48-in. stroke.

Reservoir.—Cap., about 300,000 galls.; 125 ft. above pumps; masonry in cement; 50 ft. sq., 12 ft. deep.

Stand-Pipe.—Cap., 18,700 galls.; 5 x 127 ft.

Distribution.—(In '87.) *Mains*, c. i., 3 miles. *Services*, lead. *Taps* (in '86), 350. *Meters*, none. *Hydrants*, kind not given, 45.

Consumption (in '87), 50,000 galls. *Pressure*, 50 lbs.

Financial.—(In '87.) Cost, $50,000. No debt. Ann. op. exp., not given, est., $700. Ann. rev.: consumers (in '85), $2,600; city, $540. Hydrant rental, $12.

Management.—Supt., W. R. Thomas.

NOTE.—Later figures cannot be obtained, but above is substantially correct.

CENTRALIA, *Columbia Co.* (Pop., 1,886.)

History.—Built in '66-7 by Centralia Water Co.

Water Supply.—Springs on mountain, by gravity. Supply is sometimes inadequate, when water is taken from Locust Mountain Water Co.'s works, or those of the Lehigh Valley R. R. Co.

Dams and Reservoirs.—Cap., not given; four. No further data.

Distribution.—*Mains*, 4-in. c. i., 2-in. galv. i., about 3 miles. *Services*, galv. i. *Taps*, about 250. *Meters* and *Hydrants*, none.

Consumption, about 50,000 galls. *Pressure*, 125 to 200 ft. head.

Financial.—Cost, $10,000. No debt. Ann. op. exp., not given, est., $500. Ann. rev.: consumers, not given, est., $2,500.

Management.—Prest., Edw. Williams. Secy., John W. Fortner. Treas., A. K. Mensch. Supt., Sami. A. Miller.

CHAMBERSBURGH *Franklin Co.* (Pop., 6,877; est., 9,000.) On Conococheague creek, on rolling ground. Manufactures steam engines and milling machinery. Very old town. Incorp. No sewers or electric lights.

History.—Built in '76 by town. Engr., H. P. M. Birkinbine, deceased.

Water Supply.—Surface water, from impounding reservoir on stream, pumping to reservoir, and direct pumping for fire purposes.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Birkinbine.

Reservoir.—Cap., 1,000,000 galls.

Distribution.—*Mains*, 8½ miles. *Services*, galv. i., lead. *Taps*, 862. *Meters*, none. *Hydrants*, Birkinbine, Mathews, 74. *Close of '82*: Mains, 7.2 miles. Taps, 511. Hydrants, 61.

Consumption, about 509,582 galls. *Pressure:* Ordinary, 35 lbs. Fire, 70 lbs.

Financial.—Cost (valuation), $76,410. Debt, $45,000. Int., 6%. Ann. op. exp., $3,465. Ann. rev.: consumers, $8,099; city, none. Cost, close '82, $24,861. Rev., '82, $5,236.

Management.—Supt., A. C. McGrath.

CHESTER, *Delaware Co.* (Pop., 14,937; est., 20,000.) On Delaware river, 15 miles from Philadelphia. Has good harbor, considerable commerce, and is engaged in ship-building and manufacturing. Settled in 1643. Incorp. Has sewers and electric lights.

OLD PLANT.

General Description.—Built in '67 by and to supply South Ward; Engr. Isaac S. Cassin, Philadelphia; extended in '68 to supply whole city; bought in '88 by New Chester Water Co, and made part of their plant. Supply from Delaware river, a 30-in. c. i. pipe extending 400 ft. into the stream, its outer end resting on a flat rock in 15 ft. of water at low tide. A 25-H. P. steam engine drove a pump built by C. A. Weidner, and a 60-H. P. engine built by Wetherill, of Chester, drove a 1,000,000 pump, both lifting water 106 ft. high to a 1,000,000-gall. distributing reservoir. In '78 this system had 12 miles of pipe, 1,100 taps and 57 hydrants. Original cost, $79,000, met by bonds issued on real estate of ward.

NEW CHESTER WATER CO.'S PLANT.

History.—Built in '86, put in operation June 1. (See above.) Engr., E. F. Fuller, N. Y. City. Consult. Engr., Isaac S. Cassin, Philadelphia Contr., Saml. R. Bullock, N. Y. City. Also supplies boroughs of Upland and So. Chester, having bought their plants.

Water Supply.—Delaware river, pumping to reservoir, or direct, if desired.

Pumping Machinery.—Cap., 8,000,000 galls.: two 4,000,000 Gaskill horizontal comp., cond. *Boilers:* five; 300-H. P.

Reservoir.—Cap., 12,000,000 galls.

Distribution.—*Mains*, 24 to 6-in. c. i., 30 miles. *Services*, w. i., lead. Pipe and specials from R. D. Wood & Co., Philadelphia. *Taps* (in '87), 2,200. *Meters* (in '87), 15. *Hydrants*, Ludlow, 76. *Valves*, Ludlow.

Consumption, not given. *Pressure*, 50 lbs.

Financial.—Cost, $2,400,000. Cap. stock, $2,000,000. Bonded debt, $800,000. Int., 6%. Ann. op. exp. (in '87), $7,500. Ann. rev.: consumers (in '87), $57,425; city, $3,000. Hydrant rental, $40.

Management.—Prest., J. L. Forwood. Treas., Walter Wood, Philadelphia. Gen. Supt., A. W. MacCullum, 400 Chestnut street, Philadelphia. Supt., W. Shaler Johnson.

CLARION, *Clarion Co.* (Pop., 1,169; est., 1,600.) On hilly ground on Clarion river, in oil, lumber and mining region. Settled in '39; incorp. borough in '40. Private sewers. No electric lights.

History.—Built in '75 by Clarion Water Co. Des. Engr., H. E. Rigley. Const. Engr., C. B. Thomas.

Water Supply.—Clarion river, pumping to tanks.

Pumping Machinery.—Dy. cap., 14,000 galls.; Eclipse; from Keystone Pump Works, Pittsburgh.

Tanks.—Cap., about 275,000 galls. *Old:* two; wood, 59 ft. above town. *New:* cap., 195,000 galls.; iron; built in '89.

Distribution.—*Mains*, c. i., 2 miles. *Services*, w. i., lead. *Taps*, 200. *Meters*, 6. *Hydrants*, Hutchinson & Alexander's, 11.

Consumption, 4,000 galls. *Pressure*, 40 lbs.

Financial.—Cost, $25,000. Cap. stock, $12,000. Ann. op. exp., $1,500. Ann. rev.: consumers, about $4,800; city, $165. Hydrant rental, $15.

Management.—Prest., D. B. Crull. Secy., W. H. Ross. Treas., N. Meyers. Supt., Jas. B. Knox.

CLEARFIELD, *Clearfield Co.* (Pop., 1,809; est., 3,000.) On west branch of Susquehanna river. Manufactures lumber and fire brick, and is engaged in agriculture and coal mining. Settled in '20; incorp. a borough in '30. Incomplete sewerage. Electric lights, built in '89.

History.—Built in '82-3 by Clearfield Water Co. Engr., Geo. B. Inman. Contrs., Inman Bros., all of N. Y. City.

Water Supply.—Moose creek, by gravity. Creek is mountain stream having a flow in the dryest season largely in excess of the cap. of supply pipe.

Diverting Dam.—On creek; 4 ft. high, 35 ft. long; 190 ft. above highest level of town.

Supply Main.—C. i., 10-in., 3 miles long.

Distribution.—*Mains*, c. i., 6 miles. *Services*, w. i. *Taps*, 400. *Meters*, none. *Hydrants*, Mathews, 42. *Valves*, Eddy.

Consumption, unknown. *Pressure*, 75 to 85 lbs.

Financial.—Cost, $40,000. Cap. stock, $40,000. Debt, $400. Ann. op. exp., $600. Ann. rev.: consumers, $4,500; city, $700. Hydrant rental, $16.66.

Management.—Prest., W. W. Betts. Supt., Secy. and Treas., H. F. Bigler.

COATESVILLE, *Chester Co.* (Pop,, 2,766; est., 3,000.) On Brandywine creek, on rolling ground. Has iron, paper and woolen mills. Settled in 1780; incorp. borough in '64. No sewers or electric lights.

History.—Built in '70-1 by borough. Engr., Isaac S. Cassin, Philadelphia. Not built by contract.

Water Supply.—Spring-fed stream, by gravity from collecting to distributing reservoir.

Dam and Collecting Reservoir.—Cap., 1,000,000 galls.; about 150 x 130 ft., x 13 ft. deep. Dam of rubble stone masonry, ½ mile from springs; rebuilt in '87.

Conduit.—Between reservoirs; 2,200 ft. of 10-in. c. i. pipe.

Distributing Reservoir.—Cap., 2,000,000 galls; in excavation and embankment, near, and 121 ft. above, town.

Distribution.—(Aug. 1, '89.) *Mains*, c. i., 4.8 miles. *Services*, lead. iron *Taps*, 869. *Meters*, none. *Hydrants*, kind not given, 54.

Consumption, about 120,000 galls. *Pressure*, 52 lbs.

Financial.—Cost, about $82,000. Bonded debt, $76,980. Int., 4%. Sinking fund, $2,000. Ann. op. exp., $250. Ann. rev.: consumers, $3,985; city, none.

Management.—Secy., Isaac Speakman. Treas., Wallace S. Harlan.

COLUMBIA, *Lancaster Co.* (Pop., 8,312; est., 10,000.) On Susquehanna river, 27 miles from Harrisburg. Engaged in manufacturing iron and stoves. Has electric lights.

History.—Built in '23-6 by Columbia Water Co. No Engr.

Water Supply.—Susquehanna river, and spring, by gravity, and by pumping to reservoir.

Pumping Machinery.—Dy. cap., 1,200,000 galls.; Worthington high-pressure.

Reservoirs.—Cap., est., 5,000,000 galls.; two, each 150 x 200 ft., x 12 ft. deep.

Distribution.—(In '87.) *Mains*, iron, 12 miles. *Services*, w. i. *Taps* (in '82), 1,600. *Meters*, 2. *Hydrants*, kind not given (in '82), 62.

Consumption (in '87), 400,000 galls. *Pressure*, 56 lbs.

Financial.—(In '87.) Cost, $150,000. Debt, $70,000. Int., 5%. Ann. op. exp., $5,000. Ann. rev.: consumers (in '81),$15,000; city, none,

Management.—(In '88.) Prest., J. D. Moyers. Secy., J. C. Clark. Supt., Wm. B. Fasig.

CONEMAUGH, *Cambria Co.* (Pop., 3,498). A suburb of Johnstown. Cambria Iron and Steel Works are located here.

General Description.—A blast furnace, the railroads and about 15 residences have been supplied since '76 by the Johnstown Water Co., by tapping a 20-in. main extending from a dam above Conemaugh to Johnstown. Cambria Iron Co. have a direct pumping system through a 30-in. main, which is entirely for their own use. There are no fire hydrants. All data included under Johnstown.

NOTE.—Above given in '88, prior to flood of '89.

CONNELLSVILLE, *Fayette Co.* (Pop., 3,609; est., 5,000.) On Youghiogheny river, on undulating ground. Has coke, limestone, iron and lumber industries. Incorp. No sewers. Has electric lights.

History.—Supplied in '83 by a private company; works completed in '87 by Connellsville Water Co., controlled by American Water-works & Guarantee Co., Pittsburgh. Franchise for 20 years. Works as first constructed were designed by C. W. Knight, Rome, N. Y., and Adam Miller. Supply New Haven.

Water Supply.—Springs, by gravity from two impounding reservoirs.

Reservoirs.—Cap., 20,000,000 galls. *No.* 1: cap., 5,000,000 galls.; dam of earth, across ravine. *No.* 2: cap., 15,000,000 galls.

Distribution.—*Mains*, c. i., 18 miles. *Services*, galv. i., lead. *Taps*, 620. *Meters*, none. *Hydrants*, kind not given, 88.

Consumption, 600,000 galls. *Pressure*, 135 lbs.

Financial.—Cost (in '87), $120,000. Cap. stock [authorized], $250,000. Bonded debt, $95,000. Int., 6%. Ann. op. exp , withheld, est , $2,500. Ann. rev : consumers. withheld, est., $12,000; city, about $3,500. Hydrant rental, $40.

Management.—Genl. Mgr., W. S. Kuhn, Pittsburgh. Supt., Geo. Munson.

CONSHOHOCKEN, *Montgomery Co.* (Pop., 4,561; est., 7,000.) On Schuylkill river, 14 miles above Philadelphia. Manufactures gas and water pipe, woolen and worsted goods, carpets, railroad cars and iron goods. Incorp. borough. No sewers. Has electric lights.

History.—Built in '73 by Conshohocken Gas and Water Co. Engr., Isaac S. Cassin, Philadelphia

Water Supply.—Schuylkill river, at Plymouth dam, pumping to reservoir.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two 1,000,000 Worthington; old pump has two 20-in. steam, and two 10-in. water cylinders; new, a comp., cond.

Reservoir.—Cap., 1,250,000 galls.; 185 ft. above pumps, in two compartments, with division wall and embankments carried 6 ft. above, and basins excavated 6 ft. below, ground level. Slopes and bottom lined with 18 ins. of clay, paved with brick, grouted with cement. Reservoir has given much trouble by breaking, and parts of its slopes and lining have been rebuilt.

Distribution.—*Mains*, c. i., 7 miles. *Services*, lead. *Taps*, 422. *Meters*, 34. *Hydrants*, Mathews, 52. *Close of '80*: Mains, 5 miles. Hydrants, 41.

Consumption, about 175,000 galls. *Pressure*, 60 lbs.

Financial.—Cost, $90,000. Cap. stock, $70,000. Bonded debt, $15,500. Int., 4%. Ann. op. exp., $3,289. Ann. rev.: consumers (in '87), $5,511; city, $338. Hydrant rental, $12.50 for all over 25; a 20-years contract. Cost, close '80, $76,071. Rev., '80, $3,908.

Management.—Prest., Jawood Lukens. Secy. and Treas., Alfred Craft. Supt., Wm. E. Ferrier.

CORRY, *Erie Co.* (Pop., 5,277; est., 8,000.) Railroad and manufacturing center, Incorp. No sewers. Has electric lights.

History.—Built in '86 by Corry Water Co., under [a 10-years franchise. Engr., Ellis Morrison. Contr., Saml. R. Bullock Both of N. Y. City.

Water Supply.—Hare creek, pumping from impounding to distributing reservoir.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two 1,000,000 [or 1,500,000] Gaskill dup., comp., cond. *Boilers:* made by Corry City Iron Works.

Reservoir.—*Impounding:* unofficially reported as having a cap. of 20,000,000 galls. *Distributing:* cap., est., 1,500,000 galls.; 160 x 80 ft., x 20 ft. deep.

Distribution.—*Mains*, c. i., 10¼ miles. *Services*, w. i., lead. Pipe and specials from Dennis Long & Co., Louisville, Ky. *Taps* (in '87), 240. *Meters*, not given. *Hydrants*, Ludlow, 61. *Valves*, Ludlow.

Consumption, not given. *Pressure:* Ordinary, 85 lbs. Fire, 150 lbs.

Financial.—Cost., $300,000. Cap. stock, $200,000. Bonded debt, $100,000. Int., 6%. Ann. op. exp., $3,500. Ann. rev.: consumers (in '87), $4,890; city, $3,050. Hydrant rental, $50.

Management.—Prest., J. L. Brown. Secy., Ellis Morrison. Treas., Walter Wood, Philadelphia. Gen. Supt., A. W. MacCallum, 400 Chestnut St., Philadelphia. Supt., B. F. Knouse.

DANVILLE, *Montour Co.* (Pop., 8,346; est., 9,000.) On north branch of Susquehanna river, at foot of Montour ridge, which rises to an elevation of about 450 ft. Valley at this point about ¾ mile wide. Has iron works and various other manufactories. Laid out and settled in 1792 by Danl. Montgomery; incorp. borough in '49. No sewers. Has electric lights.

History.—Built in '73 by borough. Des. Engrs., Holly Manufacturing Co., Lockport, N. Y. Const. Engr., O. H. Ostrander.

Water Supply.—North branch of Susquehanna river, direct pumping from filter gallery, or well, near river. The difference between extreme high and low water is 25.8 ft.

Filters and Pump-Well.—*Old:* 45 ins. gravel placed in timber frame 12 x 45 ft., from bottom of which water entered pump-well through drain-tile. This was used until '80, when it was inadequate. *New:* trench sunk near shore, 7½ x 90 ft., x 10 ft. deep; bottom 5 ft. below extreme low water: sides lined with ¾-in. c. i.

plates, riveted together and cross-braced with iron rods. Covered with riveted c. i. plates, and air supplied through a 4-in. pipe. Has given satisfaction. Serves as pump-well.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Holly quadruplex.

Distribution.—*Mains*, c. i., 9 miles. *Services*, iron, lead. Pipe and specials from, laid by Keller & Krebs. *Taps*, 1,200. *Meters*, none. *Hydrants*, Holly, 106. *Valves*, Ludlow.

Consumption, about 700,000 galls. *Pressure*, 65 lbs.

Financial.—Cost, $170,000. Bonded debt, $117,700: $700 at 4½, $117,000 at 4%. Sinking fund, 3% of taxes. Ann. op. exp., $5,000. Ann. rev.: consumers, $8,000; city, see Sinking fund.

Management.—Three Comrs. Prest., W. J. Baldy. Secy., Benj. Harris. Treas., Henry Amerman; Supt., Henry Kearns.

DERRY STATION, *Westmoreland Co.* (Pop., est., 2,000.) Is 15 miles east of Greensburgh. Local trade center. No sewers or electric lights.

History.—Built in '88-9 by Derry Water Co.

Water Supply.—Source not given, by gravity from two reservoirs.

Reservoirs.—Cap., 5,800,000 galls.; 2,800,000 and 3,000,000.

Distribution.—*Mains*, w. i. and cem.; c. i., 5½ miles. *Services*, lead. *Taps*, 122. *Meters*, none. *Hydrants*, Ludlow, 24. *Valves*, Ludlow.

Consumption, 350,000 galls. *Pressure*, 70 to 120 lbs.; ¾ of mains have 95 lbs.

Financial.—Hydrant rental, $20.

Management.—Prest., Clifford S. Sims. Supt., Murray Forbes, Derry Station. Treas., P. W. Janeway, Philadelphia. Date of report, May 5, '89.

DOWNINGTON, *Chester Co.* (Pop., 1,480; est., 2,000.) Manufactures paper, woollen goods, stoves and machinery. Has electric lights.

History.—Built in '74 by Downington Gas & Water Co., which was chartered in '67, and began construction in '71. Des. and Const. Engrs., Joshua Kames and Jno. B. Stevenson.

Water Supply.—Springs, by gravity from reservoirs.

Reservoirs.—Combined cap., 8,127,000 galls. Three, the first being a collecting reservoir. They are: 75 by 90 ft., x 6 ft. deep; 50 ft. sq. x 6 ft. deep; 30 ft. in diam. x 10 ft. deep.

Distribution.—*Mains*, c. i., 6 miles. *Services*, w. i., lead. *Taps*, 332. *Meters*, none. *Hydrants*, 1.

Consumption, unknown. *Pressure*, 32 lbs.

Financial.—Cost, about $50,000. Cap. stock, $50,000. Bonded debt, $4,000. Int., 7%. Ann op. exp., about $400. Ann. rev: total, $5,000, about $2,000 from Penn. R. R. Co.

Management.—Prest., P. C. Hollis. Secy. and Treas., Jos. L. Richards. Supt., Jas. Hamilton.

DOYLESTOWN, *Bucks Co.* (Pop., 1,859; est., 2,500.) In agricultural district. Incorp. No sewers or electric lights.

History.—Built in '69 by borough. Engr. and Contr., Isaac S. Cassin, Philadelphia.

Water Supply.—Springs, pumping to reservoir, and direct for fire purposes.

Pumping Machinery.—Dy. cap., 1,800,000 galls.: 1,500,000 Gaskill horizontal comp. pump, built in '83; 300,000 Worthington dup., high-pressure. *Boilers:* three; 60 and 25-H. P. iron tubular; 70-H. P. steel tubular, from Woodbury Engine Co., Rochester, N. Y.

Reservoir.—Cap., 530,000 galls.; 60 ft. diam. x 25 ft. deep; increased in '88 from 20 ft. deep.

Distribution.—*Mains*, c. i., 10 miles. *Services*, lead. *Taps*, 450. *Meters*, none. *Hydrants*, Cassin, 45. *Valves*, Cassin. *Close of* '70: Mains, 6 miles. Taps, 160 miles. Hydrants, 11. *Close of* '80: Mains, 7 miles. Taps, 325. Hydrants, 26.

Consumption, 80,000 galls. *Pressure:* Ordinary, 73 lbs. Fire, 110 lbs.

Financial.—Cost, $35,000. Bonded debt, $35,000. Int., 4%. Ann. op. exp., $1,400. Ann. rev.: consumers, $5,000; city, none. Cost, close '60, $1,000; do., '70, $11,000; do., '80, $16,000. Rev., '70, $500; '80, $3,000.

Management.—Prest., Dr. O. P. James. Secy., J. E. Zorns. Treas., S. Z. Freed. Supt. and Engr., Wm. J. Wintyen.

DRIFTON, *Luzerne Co.* (Pop., est., 1,300.)

General Description.—Built by Coxe Bros. & Co., to supply private mining town. Contr. for pump, boiler, pipe and specials, Geo. W. Hodesty; for trenching and pipe-laying, Jno. Wagner. *Mains*, 3 miles. *Taps*, 58. Financial data included in other expenses of Co. No rev.

DUBOIS, *Clearfield Co.* (Pop., est., 7,000.) Engaged in mining coal and handling lumber. Has natural gas and electric lights.

History.—Built in '89–'90 by United States Water Supply Co., Ltd.; officially tested Jan. 15, '90. Const. Engr., C. J. Shuttleworth. Contrs. for material, Mich. Pipe Co., Bay City, Mich.

Water Supply.—Springs, by gravity to and from reservoir. Springs are about 7½ miles from city, in Boons Mt. Six springs; two more may be added.

Collecting Mains.—Wyckoff. From reservoir 8-in. pipe extends 3.62 miles upwards, then reduced to 6 ins., and further on branches into 4-in. pipes. All tributaries from springs are 4-in. First connects with main 1.07 miles from reservoir; 387 ft. long. Second connects 3.43 miles from reservoir, 554 ft. long. Third, projected to connect with two additional springs. Fourth connects 4.52 miles from reservoir; 1,053 ft. to branches, one 334 long to third spring, other 1,342 ft. to fourth Fifth and sixth springs on line of main, 4.6 and 4.68 miles, respectively, from reservoir. First spring 47, two last, and principal ones, 347 and 376 ft. above reservoir, or about 600 ft. above town.

Reservoir.—Cap., 2,000,000 galls; depth, 10 ft.; on ridge 2.64 miles from point where supply main enters town, 282 above lowest part of town.

Supply Main —Wyckoff, 12-in.; length, about 3 miles.

Distribution.—*Mains*, excluding supply main, 10 to 4-in., Wyckoff, 3½ miles. *Hydrants*, Gaskill, 53; two private. *Valves*, Galvin.

Pressure, 75 to 100 lbs.

Financial.—Hydrant rental, $35. No further data.

Management.—Not given.

DUKE CENTER, *McKean Co.* (Pop., est., 700.)

General Description.—A fire protection system, consisting of 1.3 miles of mains, 13 hydrants, a force pump, and a storage tank with cap. of about 40,000 galls., situated on a hill above the village. Steam for pumping is furnished from the pumping station of the National Transit Co. Ann. op. exp., $10. Address G. H. Dana.

DUNMORE, *Lackawanna Co.* (Pop., 5,151; est., 7,000.) In coal regions 2 miles from Scranton.

History.—Built in '69–70 by Dunmore Gas & Water Co. Engr., Jno. B. Smith, Prest. of Co. Contrs., Am. Water & Gas Pipe Co., now Ferris & Halladay, Jersey City, N. J.

Water Supply.—Surface water, by gravity.

Distribution.—(In '87.) *Mains*, w. i. and cem., 5 miles. *Services*, galv. i. *Taps*, 460. *Meters*, Worthington, 6. *Hydrants*, kind not given, 4.

Consumption, not given. *Pressure*, 100 lbs.

Financial.—(In '87.) Cost, withheld, est., $75,000. Cap. stock, $150,000. Debt not given. Int., 5%. Ann. op. exp., withheld, est., $1,000. Ann. rev., consumers, withheld, est., $9,000.

Management.—(In '87.) Prest., Jno. B. Smith. Secy. and Treas., Chas. P. Savage.

NOTE.—No response to inquiries sent in '89.

EAST BRADY, *Clarion Co.* (Pop. 1,242; est., 1,500.) Engaged in coal mining.

History.—Built by Cunningham & Foster, date not given.

Water Supply.—Springs, pumping to tank.

Tank.—Cap., 372,000 galls.; 50 x 25 ft. diam., 25 ft. high.

Distribution.—(In '87.) *Mains*, ½ mile. *Services*, not given. *Taps*, . *Meters*, 2. *Hydrants*, not given.

Consumption, not given. *Pressure*, 90 lbs.

Financial.—No data. *Est.:* cost, $5,000.

Management.—Supt., J. M. Cunningham.

NOTE.—No response to inquiries sent in '89.

EAST MAUCH CHUNK, *Carbon Co.* See Mauch Chunk.

EASTON, *Northampton Co.* (Pop., 11,924; est., 15,000.) On Delaware river, on hilly ground between mouths of Bushkill creek and Lehigh river. Engaged in manufacturing and trade. Settled in 1738; incorp. borough in 1789, a city since. No sewers. Two electric light plants.

FIRST WORKS.

History.—Built in '20 by private Co. No more data.

LEHIGH WATER CO.'S PLANT.

History.—Built in '54. Des. Engr., Jno. West; for new pumping system put in in 82, H. P. M. Birkinbine, deceased. In '62 a portion of Phillipsburgh, N. J., across river, was supplied by this Co. through submerged main. Contr. for main, Jno. F. Ward, Jersey City; no repairs have been necessary.

Water Supply.—Delaware and Lehigh rivers, pumping through distribution mains to reservoir.

Pumping Machinery.—Dy. cap., 5,000,000 galls. First of present pumps erected in '60, Cornish Bull engine. In '82 a 2,000,000-gall. Corliss was added, and later 2,000,000 Worthington.

Reservoir.—Cap., 4,000,000 galls.; 180 ft. sq. x 12 ft. deep. In '81 the reservoir sprung a leak near bottom, and all but 2 ft. in depth of contents escaped through subterranean channel before leak could be stopped. A 9,000,000-gall. reservoir, 290 ft. above Delaware river, will be built in '90.

Distribution.—*Mains*, c. i., 20 mfles. *Services*, w. i., galv. i. Pipe and specials from Warren Foundry & Machine Co., Phillipsburgh, N. J. *Taps*, 1,300. *Meters*, 50. *Hydrants*, kind not given, 85. *Valves*, Cassin.

Consumption, 1,500,000 galls. *Pressure*, 20 to 100 lbs.

Financial.—Cost (in '85), $300,000. Cap. stock (in '82), $200,000. Debt, $15,000. Int., 6%. Ann. op. exp., about $10,000. Ann. rev.: consumers, $29,000; city none.

Management.—Prest., J. S. Rodenbough. Treas., J. Rader. Supt., R. P. Rader.

EBENSBURGH, *Cambria Co.* (Pop., 1,123; est., 1,200.) In Allegheny mountains, 2,000 ft. above sea. Manufactures leather, lumber and woolen goods. Settled in 1795; incorp. borough in '06. No sewers or electric lights.

History.—Built in '74 by borough. Des. Engr., Jas. Williams.

Water Supply.—Artesian well, pumping to reservoir, with auxiliary supply from pond formed by damming a creek. Well 5¾ ins. in diam., 1,000 ft. deep.

Pumping Machinery.—Dy. cap., 288,000 galls.; 3-in. Cameron pump driven by windmill, supplemented by steam power.

Reservoir.—Cap., 150,000 galls.; stone, 50 ft. in diam. x 10 ft. deep; 30 ft. above pump, 75 ft. above town.

Distribution.—*Mains*, c. i., 1½ miles. *Services*, w. i. *Taps*, 75. *Meters*, 6. *Hydrants*, Mathews, 20.

Consumption, not given. *Pressure*, 35 lbs.

Financial.—Cost, $16,000. Debt, $5,500. Int., 4%. Ann. op. exp., $500. Ann. rev.: consumers, $1,400; city, none.

Management.—Secy., W. H. Council. Supt., R. L. Thomas.

EDENBURG, (*Knox P. O.*) *Clarion Co.* (Pop., 1,000.)

History.—Built in '82 by Edenburg Water Co., principally for fire protection. Leased to Smith & Corlett.

Water Supply.—Well, pumping to tank.

Pumping Machinery.—Dy. cap., not given; driven by rod connection with engine at oil well.

Tank.—Cap., 40,000 galls.

Distribution.—*Mains*, 4 to 3-in. c. i., 2,000 ft. *Taps* and *Meters*, not given. *Hydrants*, Ludlow, 5.

Consumption, 8,000 galls. *Pressure*, 75 lbs.

Financial.—Cost, $2,000. Debt, $125. Int., 6%. Ann. op. exp., $200. Ann. rev., $200.

Management.—Lessees, Smith & Corlett. Report by N. N. Booth, Secy. Council.

ELDRED, *McKean Co.* (Pop., 1,165; est., 1,200.) On Allegheny river, in coal region. Has manufactories.

History.—Built by private subscriptions for fire protection, date not given. **Water Supply.**—River, pumping to tank. **Pumping Machinery.**—Dy. cap., about 250,000 galls.; Cameron. **Tank.**—Cap., about 40,000 galls. **Distribution.**—

Mains, w. i., about 2 miles. *Hydrants*, Chapman, 18. *Pressure*, 110 lbs. **Financial.**—Cost, $3,000. No debt. Ann. op. exp., $100. **Management.**—Five Comrs. Town Clerk, A. H. Mayo.

EMAUS, *Lehigh Co.* (Pop., 847; est., 1,200.) In mountainous farming country. Settled by Moravians in 1747; incorp. borough in '58. Has pipe foundry. No sewers or electric lights.

History.—Built in '71 by borough. Engrs., Lehr & Emery, Allentown.

Water Supply.—Two springs on Lehigh mountain, by gravity to and from reservoirs.

Reservoirs.—Cap., est., 300,000 galls. One 40 x 80 ft., x 12 ft. deep, and one 16 x 32 ft., x 12 ft. deep; masonry laid in, and lined with cement; ½ mile from, and 250 to 300 ft. above, village.

Distribution.—*Mains*, c. i., 2 miles. *Services*, w. i. *Taps*, 210. *Meters*, none. *Hydrants*, kind not given.

Consumption, not given. *Pressure*, 100 ft. head.

Financial.—Cost, $17,500. Bonded debt, $11,000. Int., 3½ and 4. Ann. op. exp., $50. Ann. rev.: consumers, $900; city, none.

Management.—Secy., H. W. Janett. Supt., Jonathan Fritz.

EMLENTON, *Venango Co.* (Pop., 1,140; est., 1,500.) On Alleghany river, in fine farming country.

History.—Built in '78 by Emlenton Water Co.

Water Supply.—Springs and river, by gravity and pumping to reservoir.

Pumping Machinery.—Dy. cap., not given; Worthington.

Reservoir.—Cap., 325,000 galls.

Distribution.—*Mains*, iron, 4 miles. *Services*, iron, lead. *Taps* and *Meters*, not given. *Hydrants*, kind not given, 17.

Consumption, not given. *Pressure*, 125 lbs.

Financial.—No data. *Est.:* cost, $35,000. Ann. op. exp., $750. Ann. rev.: consumers, $3,000.

Management.—(In '88.) Prest., C. C. Cooper. Secy. and Treas., J. J. Gosser. Supt., D. D. Moriarty.

EMPORIUM, *Cameron Co.* (Pop., 1,156; est., 2,000.) Has foundry, blast furnace and other manufactories. Incorp. No sewers or electric lights.

History.—Built in '87-8 by private Co. Engr., C. W. Knight, Rome, N. Y. Contrs., R. D. Wood & Co., Philadelphia, who furnished all material.

Water Supply.—Springs, by gravity.

Dam and Reservoir.—Cap., 1,800,000 galls. Dam of earth, with heart-wall; 160 ft. long, about 20 ft. high. Inner part of bank of puddled earth; inner slope paved. *Heart-wall:* stone, 6 ft. thick at bottom, 2 at top, 18 ft. high. *Spillway:* about 4 ft. from end of dam; 8 ft. wide, in earth, lined with masonry, free. *Discharge-pipe:* 30-in. Dam does not leak. Engr. and Contr., see History. At time of great flood, May 30, '89, water rose within 2 ins. of overflowing. Dam saved by opening discharge-pipe and by enlarging spillway.

Distribution.—*Mains*, c. i., 7 miles. *Services*, galv. i., lead. *Taps*, 130. *Meters*, none. *Hydrants*, Mathews, 25. *Valves*, Eddy.

Consumption, unknown. *Pressure*, 120 lbs.

Financial.—Cost, $33,000. Cap. stock, $30,000. Debt, $2,200. Int., 5%. Ann. op. exp., $50. Ann. rev.: consumers, $1,600; city, $1,000. Hydrant rental, $25; a 10-years contract for 25.

Management.—Prest. and Supt., J. F. Parsons. Secy., J. P. Felt. Treas., W. F. Walker.

EPHRATA, *Lancaster Co.* (Pop., 392; est., 2,500.) On Cocalico creek, in agricultural district. Settled early in the 18th century by religious sect called Dunkers.

History.—Built in '79 by Ephrata Water Co.

Water Supply.—Springs, by gravity.

Reservoir.—Cap., about 60,000 galls.

Distribution.—*Mains*, 4 to 6-in. c. i., 4,000 ft. *Services*, w. i. *Taps*, not given. *Meters*, none. *Hydrants*, not given.

Consumption, about 1,000 galls. *Pressure*, 70 lbs.

Financial.—Cost, $4,000. Cap. stock, $5,000. No debt. Ann. op. exp., nominal. Ann. rev.: consumers, $255.

Management.—Prest., R. R. Bitzer.

ERIE, *Erie Co.* (Pop., 27,737; est., 40,000.) On Lake Erie, on elevated bluff. Engaged in manufacturing and lake commerce; has natural gas wells. Site was occupied in 1749 by French fort, and town laid out in 1795; incorp. borough in '05, city in '51. Has sewers, electric lights, electric railway.

History.—First supplied in '40 from spring, through wooden pipes. There were several reservoirs for fire protection and number of private consumers. Present works built in '67-9 by city. Engr., H. P. M. Birkinbine, deceased.

Water Supply.—Lake Erie, pumping through stand-pipe to reservoir.

Intake Pipe.—A 51-in. c. i. pipe, laid in crib, 1,000 ft. into lake, to 13 ft. of water.

Pump-Well.—Well 10 x 6 ft., x 18 ft. deep, half in rock, built up from bottom with 1 ft. of hard burned brick in Portland cement; heavy copper wire screen of ⅛-in. mesh between inlet and suction pipe of engine.

Pumping Machinery.—Dy. cap., 10,000,000 galls.; two 2,500,000 Cornish Bull, 60-in. steam cylinders, 21-in. water plungers, 10-ft. stroke; one 5,000,000 Gaskill horizontal comp.

Stand-Pipe and Force Main.—Stand-pipe 251 ft. high, enclosed in masonry tower, whence 20-in. c. i. iron main leads to reservoir.

Reservoir.—Cap., 34,000,000 galls.; in excavation and embankment, in two parts, slopes puddled, and lined with brick. About 2 miles from pumping station; bottom 210 ft. above surface of lake.

Distribution.—*Mains*, c. i., 60.45 miles; guarantee of revenue fund to 7% of cost of extensions is required before same are made. *Services*, galv. i. *Taps*, 5,376. *Meters*, 80. *Hydrants*, Mathews, 333. *Valves*, Eddy.

Consumption, 3,675,912 galls. *Pressure*, 60 lbs.

Financial.—Cost, $1,006,743. Debt, $633,000. Int., 7%. Ann op. exp., $17,364. Ann. rev.: consumers, $737,042.

Management.—Three Comrs., one appointed each year by Court of Common Pleas of Erie Co. Prest., Geo. W. Starr. Secy. and Treas., B. F. Sloan. Supt. street work, Wm. O'Lone.

ETNA, *Allegheny Co.* (Pop., 2,334; est., 2,800.) On Allegheny river. Has iron and steel industries. Incorp. No sewers or electric lights,

History.—Built in '88 by Etna Water Co. Engrs. and Contrs., Jas. H. Harlow & Co., Pittsburgh.

Water Supply.—Allegheny river, pumping direct and to tank.

Filter and Intake.—Timber crib-work, 235 ft. from shore, 16 x 90 ft., sunk 9 ft. below river bed, covered with 5 ft. stone, gravel, sand.

Suction-Pipe.—Diam., 12 ins.; two 9-in. branches.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; two 500,000 Smith & Vaile dup. plunger; 18 x 9½ x 10 ins. *Boilers:* two, 4 x 14 ft. tubular.

Force Main.—C. i., 10 and 12-in., 4,800 ft. long; max. rise, 310 ft.; from A. Monroe & Sons, Pittsburgh. *Fuel:* natural gas.

Tank.—Cap., 270,000 galls.; 40 x 30 ft.; ⅜-in. w. i.; from J. B. Witherow.

Distribution.—*Mains*, 12 to 4-in., c. i., 4 miles; from National Foundry & Pipe Co., Scottdale, Pa. *Services*, lead. *Taps* (July 1, '89), 115. *Meters*, none. *Hydrants*, Mathews, 30. *Valves*, Ludlow.

Consumption, 72,000 galls. *Pressure*, 110 to 120 lbs.

Financial.—Cost, about $50,000. Debt, int., ann. op. exp., ann. rev., withheld or not determined. Hydrant rental, 30 at $50; additional at $50 for first 10 years and $40 for second 10 years.

Management.—Prest., Geo. A. Chalfant. Secy. and Treas., W. C. Steel. Supt., Chas. W. Drake.

EVERETT, *Westmoreland Co.* See Mt. Pleasant.

FOREST CITY, *Susquehanna Co.* (Pop., 990.)

General Description.—Built [probably] in '88 by Rocke-Cliffe Water Co. A 1,500,000-gall. Gordon pump built in '88. Address L. H. May.

FOXBURGH, *Clarion Co.* (Pop., 514.)

History.—Built in '77 by Foxburgh Water-Works Co.

Water Supply.—Allegheny river, pumping to tanks.

Pumping Machinery.—Dy. cap., about 20,000 galls.

Tanks.—Two, cap. about 20,000 galls. each.

Distribution.—(In '87.) *Mains*, kind not given, 2 miles. *Services*, not given. *Taps* and *Meters*, not given. *Hydrants*, kind not given, 15.

Consumption, about 12,000 galls. *Pressure*, not given.

Financial.—Not given. *Est:* cost, $15,000. Ann. op. exp., $500. Ann. rev., $1,500.

Management.—Supt., Frank Dale.

FRACKVILLE, *Schuylkill Co.* (Pop., 1,807; est., 3,000.) Is 11 miles from Pottsville, in mountainous coal and iron region. Settled in '61; incorp. borough in '76. No sewers or electric lights.

(*Not in operation.*)

History.—Built in '82 by Mountain City Water Co. under direction of Secy., Jno. Haupt. An injunction was brought against the Co. several years ago by the borough of Ashland prohibiting it from taking water from Little Mahanoy creek. Ashland has taken its supply from same creek, 2 miles below, since '76, having bought ten acres of land on stream. The land from which the above company took its supply has been owned by some of its members for 34 years. Ashland claims sole right to the water in stream above, and their claim has been sustained by Schuylkill County Court. Case went to Supreme Court in '89, but decision has not been reported.

Water Supply.—Little Mahanoy creek, pumping to reservoir. Drainage area, 5 sq. m.

Pumping Machinery.—Dy. cap., 24,000 galls.; Blake upright.

Reservoir.—Cap., about 500,000 galls.; is 100 ft. sq., 6 ft. deep, 150 ft. above pump and 50 ft. above av. elevation of town.

Distribution.—*Mains*, c. i., 2 miles. *Services*, galv. i. *Taps*, 50. *Meters* and *Hydrants*, none.

Pressure, 50 lbs.

Financial.—Cost, $20,000. No debt. No further data, as works are not in operation.

Management.—Prest. and Genl. Mgr., F. S. Haupt. Secy. and Treas., J. Haupt.

FRANKLIN, *Venango Co.* (Pop., 5,010; est., 7,500.) On French creek, near Allegheny river. In oil and natural gas region. Incorp. a city in '68. Partially sewered. No electric lights.

History.—Built in '65 by Venango Water Co. Des. Engr., Saml. Ogdin, Philadelphia. Enlarged in '78: Des. Eng., H. P. M. Birkinbine, deceased; Const. Engr., I. W. F. Sherwin; work done by Co.

Water Supply.—Springs, by gravity from collecting reservoir; French creek, direct pumping from impounding reservoir. There is an impounding reservoir on creek.

Dam and Reservoirs.—Cap., about 17,000,000 galls. *Collecting:* 162 ft. above city. No other data. *Impounding:* cap., 17,000,000 galls. Dam built across ravine. Water leaked through broken rocky strata forming hillside bordering reservoir, and passed out some distance below the dam. In '88 steps were being taken to stop leaks.

Pumping Machinery.—Dy. cap., 1,400,000 galls.; Worthington comp., dup.

Distribution.—*Mains*, c. i., 21 miles. *Services*, galv. i. Pipe and specials furnished by R. D. Wood & Co., Philadelphia. *Taps*, 1,250. *Meters*, none. *Hydrants*, Bailey, 52. *Valves*, Eddy.

Consumption (in '87), about 800,000 galls. *Pressure:* Ordinary, 45 lbs. Fire, 60 lbs.

Financial.—Cost, $166,000. Cap. stock, $100,000. Bonded debt, $46,000. Int., 5%. Ann. op. exp., $2,150. Ann. rev.: consumers, $14,000; city, $500.

Management.—Prest., F. W. Mitchell. Secy., H. W. Bostwick. Treas., Thos. Alexander. Supt., R. J. Hanna.

FREELAND, *Luzerne Co.* (Pop., est., 3,000.) In coal region; has foundry, planing mill and machine shops. Incorp. No sewers. Has electric lights.

History.—Built in '83 by Freeland Water Co.

Water Supply.—Artesian well, pumping to reservoir and direct.

Pumping Machinery.—Dy. cap., 300,000 galls.; two Worthington. *Boiler:* steel.

Reservoir.—Cap., est., 300,000 galls. Is 63 x 83 ft., x 9 ft. deep.

Distribution.—*Mains*, c. i., 3½ miles. *Services*, galv. i. *Taps*, 415. *Meters*, none. *Hydrants*, Tamaqua, 18. *Valves*, Mellert.

Consumption, 200,000 galls. *Pressure*, 65 to 80 lbs.

Financial.—Cost, $21,000. Cap. stock, $21,000. No debt. Sinking fund, $991. Ann. op. exp., $2,500. Ann. rev.: consumers, $4,700; city, $225. Hydrant rental, $15.

Management.—Prest., Jos. Birkbeck. Secy., F. Schilcher. Treas., Thos. Birkbeck. Supt., H. Fisher.

FREEPORT, *Armstrong Co.* (Pop., 1,614; est., 2,000.) On Allegheny river, 29 miles from Pittsburgh. Incorp. No sewers or electric lights.

History.—Built for domestic supply in '83-4 by Freeport Water-Works Co. Engr., S. P. McRea, Freeport. Co. did work.

Water Supply.—Allegheny river, pumping to tanks.

Intake Crib.—Timber, 7 ft. sq. x 7 ft. high, covered with 2-in. plank, cross-covered with inch boards. This is sunk in gravel bed of river and covered with 18 ins. of gravel; water enters bottom satisfactorily.

Pumping Machinery.—Dy. cap., not given. First pump was a Fort Pitt plunger, 12 x 6 x 18 ins.: built by Wilson & Snyder. Later, Blake dup. was added.

Tanks.—Cap. not given; two of wood, 3,000 ft. from, 200 ft. above, center of town.

Distribution.—*Mains*, kal. w. i., about 5 miles. *Services*, w. i. *Taps*, about 250. *Meters* and *Hydrants*, none.

Consumption, not given. *Pressure*, 85 lbs.

Financial.—Cost (in '87), $12,000. No debt. Ann. op. exp. (in '84), $800. Ann. rev.: consumers (in '84), $1,000.

Management.—Prest., Jno. Ralston. Secy. and Treas., G. M. Hill. Supt., D. Golden.

GETTYSBURGH, *Adams Co.* (Pop., 2,514; est., 3,300.) No sewers or electric lights.

History.—Built "a great many years ago" by Gettysburgh Water Co.

Water Supply.—Driven well, 100 ft. deep, on East Cemetery hill, pumping direct and to reservoir.

Pumping Machinery.—Dy. cap., 86,400 galls.; pump driven by windmill.

Reservoir.—Cap., 900,000 galls.; about 50 ft. from, 25 ft. above, pump. Built [probably] in '82. Engr., Robt. K. Martin, Baltimore, Md.

Distribution.—*Mains*, kind not given, 2 miles. *Services*, not given. *Taps*, about 300. *Meters*, none. *Hydrants*, kind not given, 30.

Consumption, about 60,000 galls. *Pressure*, 50 lbs

Financial.—Cost, withheld, est., $25,000. Cap. stock, paid up, $22,280; authorized, $25,000. Debt, nominal floating. Ann. op. exp., about $1,100. Ann. rev.: consumers, about $2,000; city, $400. Until '82 cap. stock was about $6,000, and cost was then about the same.

Management.—Prest., Chas. Horner. Secy. and Treas., J. W. Kendlehart. Supt., David Warren.

GILBERTON, *Schuylkill Co.* (Pop., borough, 3,098.)

History.—Built in '79 and extended in '84 by Anthracite Water Co., principally to supply anthracite collieries and railroad engines in Mahanoy and Shenandoah valley, and incidentally to supply Gilberton. Engrs., see Reservoirs.

Water Supply.—Mud and Waste House runs, by gravity from reservoirs.

Dams and Reservoirs.—Cap., 140,000,000 galls. *Mud Run:* cap., 80,000,000 galls.; area, 40 acres. Dam 1,200 ft. long, 26 ft. high. Built in '79. Des. Engr., H. K. Nichols, Philadelphia. Const. Engr., S. B. Whiting. *Waste House:* cap., 60,000,000 galls.; area, 10 acres. Dam 419 ft. long, 53 ft. high. Built in '81. Des. Eng., H. K. Nichols. Const. Engr., R. C. Luther, Pottsville. Contr., Thos. H. Rickert, Pottsville.

Distribution.—(Feb. 28, '90.) *Mains*, 10 to 4-in. hautboy. *Services*, ¼-in. lead, 1 and 2-in. w. i., 3 and 4-in. hautboy. Pipe and specials from Donaldson Iron Co., Emaus; trenching and pipe-laying done by Jno. Brown, Mahanoy City. *Taps*, about 200. *Meters*, none. *Hydrants*, 25. *Valves*, Ludlow, Matthews, Cassin.

Consumption, 1,000,000 galls. *Pressure*, 100 to 150 lbs.

Financial.—(Feb. 28, '90.) Cost, $150,000. No debt. Ann. op. exp., $1,000. Further data withheld.

Management.—Prest., R. C. Luther. Secy. and Treas., Frank Carter. Supt., Geo. S. Clemens. All of Pottsville.

GIRARDVILLE, *Schuylkill Co.* (Pop., 2,730; est., 4,000.) In coal region. Incorp. borough. No sewers or electric lights.

GIRARD WATER CO.'S WORKS.

History.—Built in '79-80 to supply collieries and tenants of Girard estate, and incidentally borough of Girard. Engr., Heber S. Thompson, Pottsville. Contrs., C. I. King, Mahanoy City; Thos Richert, Pottsville.

Water Supply.—Lost creek, by gravity.

Dams and Reservoir.—Cap., 120,400,000 galls.; three; 35,000,000, 85,000,000, 400,000 galls., respectively. Dams not described.

Distribution.—*Mains*, 8 to 4-in. c. i., 7 miles. *Services*, ¾ and ½-in., material not given. *Taps*, 12, not including borough works, which see. *Meters*, Gem, Union, Crown, Empire, 12. *Hydrants*, see borough works. *Valves*, Ludlow.

Consumption, 273,000 galls., including 40,000 for borough. *Pressure*, see borough.

Financial.—Cost, $102,057. Cap. stock, $100,000. Debt, none. Total payments, '88, $8,983; viz.: rent of pipe-lines, $4,000; dividends, $4,447; taxes, $300; repairs, $203; misc., $3. Ann. rev.: consumers, $8,784.

Management.—Prest., Louis Wagner. Secy., Geo. E. Kirkpatrick. Treas., F. M. Heighley. All of Philadelphia. Supt., E. C. Wagner.

BOROUGH'S WORKS.

History.—Built in '81. Const. Engr., E. C. Wagner, Girardville.

Water Supply.—Girard Water Co.'s Works.

Distribution.—*Mains*, c. i., about 4 miles. *Services*, not given. *Taps*, about 300. *Hydrants*, Adams, Tamaqua, 30. *Valves*, Ludlow.

Consumption, 40,000 galls. *Pressure*, 130 lbs.

Financial.—Cost, $16,000. Debt, $16,000. Int., 4%. Ann. op. exp. about $600. Ann. rev.: consumers, $1,200; city, none

Management.—Clerk, W. G. Parker. Supt., Patrick O'Brien.

CLENSIDE, *Montgomery Co.* See Jenkintown.

CORDON, *Schuylkill Co.* (Pop., not given.)

NOTE.—Hadesty Water Co. supplies water. No further data.

GREENSBURGH, *Westmoreland Co.* (Pop., 2,500; est., 5,000.) In agricultural, coal mining and natural gas district. Heated and lighted by natural gas, some of the largest wells in the country being three miles from town. Incorp. No sewers. Has electric lights.

History.—Built in '88 by Westmoreland Water Co., of Unity Township. Engr., C. W. Knight, Rome, N. Y. Contr., Penn. Pipe Mfg. Co., Germantown, Pa. Extended in '89 to supply Jeanette, Penn, Manor and Irwin. Distance from source of supply to Irwin, 22 miles.

Water Supply.—Several streams on Chestnut Ridge, by gravity from impounding to storage and distributing reservoirs. Streams are Armel, Sewickley, Nine Mile Run, and five or six smaller ones.

Impounding Dams and Reservoir.—Cap., 150,000,000 galls.; area, 28 acres; av. depth, 25 ft. Situated between Chestnut Ridge and subordinate parallel hills. Dam at each end, earth, about 1,200 ft. long, almost 35 ft. high.

Supply Main.—About 22 miles long, passing through several towns supplied. Diam. not given.

Tunnel.—Through Grapeville Ridge, between Ludwick and Jeanette; carries supply main. No further data.

Storage and Distributing Reservoirs.—Cap., above 83,000,000 galls. *Dry Ridge:* cap., not given; circular; distributing for Greensburgh. *Jeanette:* cap., 75,000,000 galls.; distributing for Jeanette, Penn, Manor. *Irwin:* cap., about 8,000,000 galls.

Distribution.—*Mains*, w. i. and cem., Phipps' patent, 20 miles. *Services*, lead. *Taps*, none made. *Hydrants*, kind not given, 35. *On May* 10, '89: *Taps*, 174. *Meters*, 6. *Hydrants*, 37.

Consumption, for '89, est., 125,000 galls. *Pressure*, not given.

Financial.—Cost, est., $300,000. Cap. stock, debt, int., not given. Ann. op. exp., ann. rev., not determined. Hydrant rental, $50.

Management.—Prest., Geo. F. Huff. Secy. and Supt., Murray Forbes. Treas., P. W. Janeway, Philadelphia.

GREENVILLE, *Mercer Co.* (Pop., 3,007; est., 4,600.) On Shenango river, in farming and coal region. Has rolling mills and manufactories. Incorp. No sewers or electric lights.

History.—Built in '85-7 by Greenville Water Co. Engr., C. W. Knight, Rome, N. Y. Contr. for masonry and buildings, S. R. Cochran, Greenville.

Water Supply.—Springs, by gravity from elevation of 180 ft.

Reservoir.—Cap., 8,000,000 galls.

Distribution.—*Mains*, c. i., 5 miles. *Services*, galv. i., lead. Pipe and specials from R. D. Wood & Co., Philadelphia. *Taps*, about 300. *Meters*, none. *Hydrants*, Mathews, 35. *Valves*, Eddy.

Consumption, unknown. *Pressure*, 85 lbs.

Financial.—Cost, $128,031. Cap. stock, $84,000. Bonded debt, $42,000. Int., 6%. Ann. op. exp. (in '87), $600. Ann. rev.: consumers (in '87), $2,295; city, $1,225. Hydrant rental, $35.

Management.—Prest., J. T. Blair. Secy., P. E. McCray. Treas., A. F. Henleim. Supt., S. R. Cochran.

HAMBURGH, *Berks Co.* (Pop., 2,010; est., 2,300.) On Schuylkill river, 18 miles from Reading.

History.—Construction begun Dec. 2, '89, by Windsor Water Co.; to be finished about June 1, '90. Surveys made by M. M. Dreibelbis. Contr., Howard E. Abrens, Reading.

Water Supply.—Mill creek, by gravity from impounding and distributing reservoirs.

Dam and Impounding Reservoir.—No data.

Conduit.—Connecting reservoirs. No data.

Distributing Reservoir.—Cap., 1,000,000 galls.; 16,200 ft. from town, 339 ft. above Main and State Sts.; in embankments; slopes, 2 to 1, inner covered with 2 ft. of puddled clay, then paved with brick on edge and lined with 1½ to 2 ins. of cem. mortar. Engr, Emil Nuebling.

Supply Main.—Diam., 8 and 10 ins; length, 16,200 ft.

Distribution.—(Feb. 10, '90.) *Mains*, excluding supply, 8 to 4-in., 3 miles. *Hydrants*, 25.

Financial.—Hydrant rental, $20.

Management.—Prest., P. D. Wanner. Treas., R. B. Kinsey. Latest report, Feb, 10, '90.

HANOVER, *York Co.* (Pop., 2,317; est., 5,000.) In elevated valley. Incorp. No sewers or electric lights.

History.—Built in '74 by Hanover Water Co. Des. Engr., Robert K. Martin, Baltimore.

Water Supply.—Mountain springs, by gravity from collecting reservoirs.

Dams and Reservoirs.—Combined cap., 4,000,000 galls.; two; 2,500,000, and 1,500,000 galls.; 175 ft. above town. Dams not described.

Distribution.—*Mains*, c. i., 6½ miles. *Services*, c. i. *Taps*, 425. *Meters*, 5. *Hydrants*, Reading, 32. *Valves*, Ludlow. *Close of* '80: Mains, 6 miles. Taps, 280. Meters, 1. Hydrants, 25.

Consumption, 50,000 galls. *Pressure*, 80 lbs.

Financial.—Cost, $38,325. Cap. stock, $30,000. No debt. Ann. op. exp., $1,000. Ann. rev.: consumers, $3,484; city, $160. Cost, close of '80, $37,071. Rev., for '80, $2,400.

Management.—Prest. and Supt., Stephen Keefer. Secy. and Treas., R. M. Wirt.

HARRISBURG, *Dauphin Co.* (Pop., 30,762; est., 43,000.) On Susquehanna river, mostly on plateau 26 to 50 ft. above river and extends back on hills. Has large iron manufactories. Settled in 1726; incorp. a borough in 1791; a city in '60. Has sewers and two electric light companies.

History.—Built in '40 by borough, and new works built in '72-4 by city. Engr. of first works, F. Erdman; of present works, H. P. M. Birkinbine, deceased.

For first works a 30-in. c. i. pipe, laid to a point 108 ft. from shore of Susquehanna river, conducted water to pump-well, from which it was pumped to a reservoir through an 8-in. c. i. pipe, by a horizontal high-pressure crank and fly-wheel pumping engine, 12 x 8 x 60 ins. Reservoir was 150 ft. sq., x 16 ft. deep, 2,046 ft. from pump and 91.32 ft. from low-water in river. In '60 a 2,000,000-gall. Worthington dup. pump was added, and a 16-in. force main laid. In '67-9 dy. consumption was 1,089,089 galls., and the works had cost $225,000. The new works, as built in '74 and extended since, are described below.

Water Supply.—Susquehanna river, pumping through base of stand-pipe to reservoir.

Intake.—Two 30-in. mains, extending 250 ft. into current, leading to pump-well.

Pumping Machinery.—Combined dy. cap., 12,000,000 galls. The two pumps put in with the new works in '74 were made by Harrisburg Car Co., and consisted of

horizontal crank and fly-wheel engines, one non-cond., 30 x 22½ x 60 ins., other cond., 54 x 19½ x 60 ins. They are arranged to work separately or as a comp. engine. Knowles pump has also been put in, 20 x 14 x 24 ins.

Force Main.—Diam., 30 ins.; length, 9,600; rise, 200 ft.

Stand-Pipe.—Cap., 30,000 galls.; 5 x 205 ft.; enclosed in ornamental brick tower. Contrs., Harrisburg Car Co.

Reservoir.—Cap., 20,000,000 galls.; in excavation and embankment, 275 x 525 ft. at top, 194 x 444 ft. at bottom, 27 ft. deep. Division wall in center, 12 ft. deep, 10 ft. wide on top, 46 ft. at bottom, 194 ft. long. Inner slopes and bottom lined with brick. Contr., J. Criswell.

Supply Main.—Diam., 30 ins.; length, 7,800 ft.

Distribution.—*Mains*, 30 to 4-in. c. i., 29½ miles. *Services*, lead, galv. i. Pipe and specials from J. W. Starr & Sons, Camden, N. J.; pipe laid by Robt. Hicks. *Taps*, 8,200. *Meters*, Crown, 200. *Hydrants*, Ludlow, Mathews, about 429. *Valves*, Ludlow, Eddy.

Consumption, 6,635,963 galls. *Pressure*, 40 to 75 lbs.

Financial.—Cost, est., $1,000,000. Bonded debt, about $520,000 [possibly more, as some of it is combined with other city debts]. Int., 6% on $449,900; remainder not given. Ann. op. exp., $22,000. Ann. rev.: total, $75,196.

Management.—Four Comrs. Prest., E. Mather, who acts as Supt. Secy., J. B. D. Koons.

HAZLETON, *Luzerne Co.* (Pop., 6,935; est., 14,500.) Engaged in coal mining manufacturing hats and wagon springs, and is center of trade for 50,000 people within radius of 15 miles. Has electric lights.

History.—Built in '60 by Hazleton Water Co.

Water Supply.—Springs, by gravity from collecting reservoirs, with pumping as auxiliary.

Reservoirs.—*Old:* cap., 25,000,000 galls.; five, all but one being on south side of town, about 70 ft. above it. Other is about two miles distant, over a ridge, and water is pumped from it only during dry summer months. It is unofficially reported that the supply depends altogether upon rainfall and that water is raised from reservoir to top of ridge, whence it flows into the other reservoirs. *New:* cap., not given. Built in '88. Cost, $20,000.

Pumping Machinery.—Cap., 1,440,000 galls. *Old:* home-made pump and locomotive boiler. *New:* no data.

Distribution.—*Mains*, c. i., 12 miles. *Services*, w. i. lead. *Taps*, 2,000. *Meters*, 6. *Hydrants*, Cassin, 26. *Valves*, Cassin.

Consumption, 500,000 galls. *Pressure*, 18 lbs.

Financial.—Cost, 200,000. Cap. stock, $200,000. No debt. Ann. op. exp., in '85, $3,580. Ann. rev.: consumers, withheld, est., $25,000; city, $350. Hydrant rental, $18.50.

Management.—Prest., E. P. Wilber. Secy. and Treas., T. M. Santee. Supt., D. Clark.

HOLLIDAYSBURGH, *Blair Co.* (Pop., 3,120; est., 5,000.) On Juniata river, at western foot of Alleghany range. Engaged in coal mining and iron manufacturing. Incorp. Partially sewered. Has electric lights.

History.—Built in '67 by borough. Engr., Jno. Branley.

Water Supply.—Roaring run, by gravity, water being taken 3 miles from, and 279 ft. above, town. Additional supply projected; est. cost, $15,000.

Distribution.—*Mains*, c. i., 14 miles. Supply and distributing mains were originally of Wyckoff wood, but have been changed to c. i. *Services*, w. i. *Taps*, 800. *Meters*, none. *Hydrants*, Ludlow, 50. *Valves*, Eddy.

Consumption, 200,000 galls. *Pressure*, 50 lbs.

Financial.—Cost, $75,000. Debt, $8,500. Int., 4%. Ann. op. exp., $300. Ann. rev.: consumers, $8,000; city, none.

Management.—Three Comrs. Supt., C. A. McFarland.

HOLMESBURGH, *Philadelphia Co.* (Pop., est., 2,000.) A suburban town within city limits of Philadelphia.

History.—Built in '87-8 by Holmesburgh Water Co. Engr., Isaac S. Cassin, Philadelphia.

Water Supply.—Sandy run, pumping from subsiding reservoir to stand-pipe.

Dam.—No data.

Subsiding Reservoir.—Cap., 1,500,000 galls.; 80x250 ft., 12 ft. deep; in excavation and embankment; inner slopes, 1½ to 1, paved with stone.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Gaskill dup.

Stand-Pipe.—Cap., 100,000 galls.; from Harrisburg Stove & Boiler Works.

Distribution.—*Mains*, c. i., 5½ miles. *Services*, not given. *Taps*, 128. *Hydrants*, kind not given, 35.

Consumption, 125,000 galls. *Pressure*, not given.

Financial.—Cost, $44,000. Cap. stock, $30,000. No debt. Ann. op. exp., $1,600. Ann. rev.: consumers, $1,200; city, none.

Management.—Prest., Wm. B. Bunker. Secy., A. C. Shallcrass. Treas., J. Rowland. Supt., Isaac S. Taylor.

HONESDALE, *Wayne Co.* (Pop., 2,620; est., 5,000.) On Lackawaxen creek. Has extensive coal trade, and silk and other manufactories. Has electric lights.

History.—Built in '65-7 by Honesdale Water Co. Engr., W. R. Moffett, Wilkes-Barre.

Water Supply.—Two ponds, 5 miles distant, by gravity to reservoir.

Supply Main.—Terra cotta and cem.; diam. and length, not given.

Reservoir.—No data.

Distribution.—*Mains*, c. i., 10 miles. *Services*, not given. *Taps*, 400. *Meters*, none. *Hydrants*, Brightwood (in '82), 8. *Valves*, Ludlow. *Pressure-recording gauge*, Edson.

Consumption, 100,000 galls. *Pressure*, 55 lbs.

Financial.—Cost, $28,000. Debt, $20,000. Int., 7%. Ann. op. exp. (in '81), $1,600. Ann. rev. (in '81), $3,000.

Management.—Secy., H. C. Hand. Treas. and Supt., W. R. Moffet. Asst. Supt., F. D. Thayer.

HORATIO. *Jefferson Co.* See Reynoldsville.

HUMMELSTOWN, *Dauphin Co.* (Pop., 1,013; est., 1,600.) Is 9 miles from Harrisburg. Has planing mill, machine shop, foundry, terra cotta works carriage factories and quarries of brown sandstone. Incorp. No sewers or electric lights.

History.—Built in '88 by Hummelstown Water Co., who own flouring mill and run it in connection with works. Charter perpetual. Engrs. and Contrs., Raymond & Campbell, Middletown.

Water Supply.—Swatara creek, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 23,000 galls.; Raymond & Campbell, Middletown. Run in connection with flouring mill owned by Co. Three hours a day of pumping furnishes all water needed.

Stand-Pipe.—Cap., 150,000 galls.; 100x16 ft.; from Raymond & Campbell, Middletown.

Distribution.—*Mains*, kind not given, 3 miles. *Services*, not given. *Taps*, 120. *Meters*, none. *Hydrants*, kind not given, 22.

Consumption, not yet known. *Pressure:* Ordinary, 75 lbs. Fire, 150 lbs.

Financial.—Cost, about $24,000. Flouring mills and water-works together cost $54,000; total cap. stock of Co. is $22,500; bonded debt, $29,500. Int., 6%. Ann. op. exp., not given, est., $500. Ann. rev.: consumers, $1,110; city, $630 for 18 hydrants. Hydrant rental, $35.

Management.—Board of Directors. Prest., F. J. Schaffner. Secy., W. H. Siple. Treas., Geo. H. Grove.

HUNTINGDON, *Huntingdon Co.* (Pop., 4,125; est., $5,000.) On Juniata river. Engaged in manufacturing and mining. Incorp. Has sewers and electric lights.

PENITENTIARY WORKS.

General Description.—Built in '79 by State. Water from three springs is collected in a 96,000-gall. reservoir, and conveyed thence through 3,300 ft. of 8-in. pipe, having a fall of 26 ft. Contr., W. W. Morrison, Lock Haven. Cost, $5,450.

HUNTINGDON WATER CO.'S WORK.

History.—Built in '85-6. Co. not incorp. No Engr.

Water Supply.—Standing Stone creek, pumping to reservoir, and pumping direct.

Pumping Machinery.—Dy. cap., 750,000 galls.; Knowles comp., cond.

Reservoir.—Cap., about, 1,500,000 galls.

Distribution.—*Mains*, c. i., 12 miles. *Services*, galv. i. Pipe and specials from Gloucester Iron Works, Philadelphia. Trenching done by R. H. Hill, Williamsport, and pipe laid by J. Detmor. *Taps*, 337. *Meters*, 1. *Hydrants*, kind not given, 42.

Consumption, 200,000. *Pressure*: Ordinary, 80 lbs. Fire, 120 lbs.

Financial.—Cost, $75,000. Bonded debt, $60,000. Int., 4% Ann. op. exp., not given. Ann. rev.: consumers, est., $4,800; city, $1,600. Hydrant rental, $40 each for 10.

Management.—Chn., H. B. Melick. Secy. and Treas., H. Hinckley. Both of Williamsport. Supt., Irvin Hoffman.

IRWIN, *Westmoreland Co.* (Pop., 1,444; est., 5,000.) Is 21 miles from Pittsburgh; engaged in coal mining. Incorp. village.

History.—Built in latter part '89 by Irwin Water Co. Des. Engr., C. W. Knight, Rome, N. Y. Contr., American Pipe Mfg. Co., Philadelphia.

Water Supply.—Westmoreland Water Co.'s works, by gravity from one of the reservoirs. See Greensburgh.

Distribution.—*Mains.* w. i., and cem., about 5 miles. *Services.* lead. *Hydrants,* Ludlow, 25.

Financial.—Hydrant rental, $25.

Management.—Prest., F. Z. Shellenberg. Secy. and Supt., Murray Forbes, Greensburgh. Treas., J. D. Brown. Date report, Oct. 12. '89.

JEANETTE, *Westmoreland Co.* See Greensburgh.

JENKINTON, *Montgomery Co.* (Pop., 810.) Is 9 miles north of Philadelphia.

History.—Built in '89 by Jenkinton Water Co.; put in operation Oct. 25. Supply Jenkinton, Wyncote, Noble, Glenside and Heasick. Engrs., Wilson Bros. & Co., Philadelphia.

Water Supply.—Two artesian wells, over 300 ft. deep, pumping to tank.

Pumping Machinery.—Dy. cap., not given; two Downie artesian well pumps. *Boilers:* from Edgemoore Iron Co., Wilmington, Del.

Tank.—Cap., 100,000 galls.; on iron trestle, 106 to 116 ft. high; from Wharton R. R. Switch Co.

Distribution.—*Mains,* 8 to 4-in. c. i., 8½ miles. Pipe and specials from, and pipe laid by, Caswell & Moore, Phœnixville, Pa. *Taps,* about 40. *Meters,* none. *Hydrants,* Mathews, 28. *Valves.* Cassin.

Pressure, 50 to 100 lbs.

Financial.—Cost, $40,000.

Management.—Prest., M. L. Kohler. Secy., I. W. Ridpath. Treas., Chas. F. Wilson. Report March 11, '90.

JERMYN, *Lackawanna Co.* (Pop., 1,541; est., 2,500.) Incorp. borough. No sewers or electric lights.

History.—Built in '84 by Jermyn Water Co. Work done by day under direction of F. S. Pecke.

Water Supply.—Aylesworth creek, by gravity.

Dam and Reservoir.—Cap., not given; area, ¼ acre; depth at dam, 8¼ ft. Dam of earth, with heart-wall 180 ft. long, 10 ft. 11 ins. high; founded on rock; both slopes unpaved. *Heart-wall:* stone, carried about 13 ft. below natural surface, within 1 ft. of top. *Spillway:* about 20 ft. from south end of dam, in earth, lined with masonry, free; 32 ft. wide, 2 ft. deep. *Discharge-pipe:* 8-in. *Culvert:* 24-in. Dam does not leak. Built in '88 to replace old crib dam. Engr. and Contr., Co. Cost, $5,000.

Distribution.—*Mains.* c. i., 7¼ miles. *Services,* galv. i. Pipe and specials from Warren Foundry & Machine Co., Phillipsburgh, N. J. *Taps.* 250. *Meters,* none. *Hydrants,* Ludlow, 11. *Valves,* Ludlow.

Consumption, unknown. *Pressure,* 110 lbs.

Financial.—Cost, $34,000. Cap. stock, $30,000. No debt. Ann. op. exp., $500. Ann. rev.: consumers, $5,000, of which $1,000 is from collieries and $550 from manufactories; city, $150. Hydrant rental, $15.

Management.—Prest., J. J. Jermyn. Secy., Treas. and Supt., W. S. Hutchings.

JERSEY SHORE, *Lycoming Co.* (Pop., 1,411; est, 2,000.) On West Branch Susquehanna river, 12 miles from Williamsport. Incorp. Partially sewered. No electric lights.

History.—Built in '84-5 by Jersey Shore Water Co. Engr., E. D. Trump, present Supt.

Water Supply.—Springs and surface water, pumping to reservoir.

Pumping Machinery.—Cap., 1,000,000 galls.; Knowles comp., cond. A 750,000 Worthington also reported. *Boiler:* horizontal, tubular.

Reservoir.—Cap., 2,500,000 galls.; 100x200 ft.; about 16 ft. deep; on hill 130 ft. above town; excavated 8 ft. in clayey gravel, 12 ft. of embankment. Banks about ft. wide on top; slopes, about 1 to 1, unpaved. Built in '84. Engr., see History. Cost, $1,300. Does not leak.

Distribution.—*Mains*, c. i., 4 miles. *Services*, galv. i. *Taps*, 110. *Meters*, none. *Hydrants*, Mathews, 31.

Consumption, 500,000 galls. *Pressure*, 55 lbs.

Financial.—Cost $50,000. Cap. stock, $75,000. Bonded debt., $20,000. Int., 5% Sinking fund, $600. Ann. op. exp., $600. Ann. rev.: consumers, $2,300; city, $1,090. Hydrant rental, $40 for first 25, $30 for additional.

Management.—Prest., Treas. and Supt., E. D. Trump, Secy., H. C. Trump.

JOHNSTOWN, *Cambria Co.* (Pop., 8,380; est. pop. supplied, 30,000.) At foot of Alleghany mountains, on hilly ground on the Conemaugh river. Manufactures iron, steel, wire, cement, fire-brick, leather and woolen goods. Settled about 1800. Has sewers and electric lights.

History.—Built in '67 by Johnstown Water Co. Supplies water in 13 boroughs ncluding village of Conemaugh.

Water Supply.—By gravity from Conemaugh and St. Clair rivers, Laurel run and Mill creek, all mountain streams. Latter supply introduced in '86 or '87. May 24, '89, Co. reported as in progress the introduction of an additional supply from Stony creek, consisting of a 30-in. supply main, 4 miles long, partly in tunnel. Contrs., Brown & Emery; pipe from R. D. Wood & Co., Philadelphia.

Dams and Reservoirs.—Est. cap. of five, 150,000,000 galls. *Laurel Run:* cap., 5,500,000 galls.; is 165 ft. above the city. Dam of clay, 19 ft. high.

St. Clair: cap., 25,000,000 galls.; 175 ft. above city. Dam of earth, 20 ft. high, with puddle heart-wall and riprap slope. Water conveyed to junction with Laurel run main by 3 miles of 12-in. c. i. pipe.

Conemaugh: cap., 6,000,000 galls.; 2½ miles above Conemaugh, and about 5 miles from Johnstown, at an elevation of 154 ft. Dam of stone-filled timber cribs, planked over, 6 ft. high.

Mill Creek: no data.

Conduits and Supply Mains.—*Laurel Run:* reservoir to city; 5 miles 16-in. c. i. *St. Clair:* reservoir to junction with Laurel Run main; 3 miles 12-in. c. i. *Conemaugh:* reservoir to city; 5 miles 20-in. c. i, *Stony Creek:* see Water Supply.

Distribution.—*Mains*, c. i., 41 miles. *Services*, lead. *Taps*, 2,800. *Meters*, none. *Hydrants*, Mathews, 104. *Valves*, Ludlow.

Consumption, unknown. *Pressure*, 70 lbs.

Financial.—Cost, $474,000. Cap. stock, $375,000. Bonded debt (in '88), $85,000. Int., 4%. Ann. op. exp. (in '87), $4,500. Ann. rev.: consumers (in '87), $60,000; city pays $500 for each new hydrant, which is perpetual lease; private parties pay hydrant rental of $37.50.

Management.—Prest., Jas. McMillen. Secy., Jas. Potts. Treas., H. J. Roberts. Supt., Jas. Williams.

NOTE.—Inquiries have been sent to ascertain damage to works by flood of May 30, '89, but no reply has been received.

STONY CREEK WATER CO.'S WORKS.

History.—Built in '88; put in operation Oct. 30. Des. Engr., Jno. Coffin. Const. Engr. and Contr., Jas. A. McMillan.

Water Supply.—Springs, by gravity.

Distribution.—*Mains*, 4-in., 2 miles. *Taps*, 61. *Hydrants*, Ludlow, 3. *Valves*, Ludlow.

Consumption, 10,000 galls. *Pressure*, 46 to 100 lbs.

Financial.—Cost. $10,000. Cap. stock, authorized, $40,000. No debt. Ann. op. exp., $300. Ann. rev.; consumers, $975.

Management.—Prest., E. B. Entivisle. Secy. and Treas., A. J. Moxham. Supt., Johnson Allen.

KENNETT SQUARE, *Chester Co.* (Pop., 1,021; est., 1,500.) In agricultural region, 33 miles from Philadelphia. Has foundry and the works of American Road Machine Co.

History.—Built in '42 by company, purchased by borough in '50, extended or rebuilt in '65; also extended in '88, with Jno. Scott, Philadelphia, as Des., and J. McMullin, Kennett Square, as Const. Engr.

Water Supply.—Surface water and spring, pumping to reservoir and stand pipe.

Pumping Machinery.—Hy. cap., not given; from E. T. Cope.

Reservoir.—Cap., 38,000 galls.

Stand-Pipe.—Cap., 45,000 galls.; 16 x 30 ft.

Distribution.—*Mains*, c. i., 4½ miles. *Services*, iron, lead. Pipe and specials for extensions in '88, from R. D. Wood & Co., Philadelphia. *Taps* and *Meters*, not given. *Hydrants*, kind not given, 15.

Consumption, not given. *Pressure*, 5 to 40 lbs.

Financial.—Withheld. *Est.:* cost, $40,000. Ann. op. exp., $200. Ann. rev.: consumers, $2,500.

Management.—Supt., E. P. Mercer.

KINGSTON, *Luzerne Co.* (Pop., 1,418; est., 1,700.) One mile from Wilkes-Barre.

General Description.—Spring Brook Water Co. built works several years ago. Important extensions were made with intention of eventually supplying 100,000 inhabitants. Supply, Spring brook. Cap. stock, paid in, $600,000. Bonds issued, $300,000. Prest., L. D. Shoemaker, Wilkes-Barre. Secy., L. A. Waters, Scranton. Treas., Abram Nesbitt. Date of report, Nov. 27, '89. See Moosic.

KITTANING, *Armstrong Co.* (Pop. 2,261; est., 4,000.) On Allegheny river, in coal and iron region. Has manufactories. Incorp. borough in '03. No sewers or electric lights.

History.—Built in '71 by Kittaning Water Co.

Water Supply.—Allegheny river, pumping to reservoir.

Pumping Machinery.—Dy. cap., not given; Keystone.

Reservoir.—Cap., 1,500,000 galls.

Distribution.—*Mains*, c. i., 11 miles. *Taps*, withheld, est., 460. *Meters*, none. *Hydrants*, Mathews, 30. *Valves*, mostly Eddy.

Consumption, not given. *Pressure*, 80 lbs.

Financial.—Cost, withheld, est., $75,000. Cap. stock, $50,000. Bonded debt, $20,000. Int., not given. Ann. op. exp., withheld, est., $1 500. Ann. rev.: consumers, withheld, est., $7,000; city, $650. Hydrant rental, $21.66.

Management—Prest., G. C. Orr. Supt., Secy. and Treas., W. B. Meredith.

KNOX, *Clarion Co.* (Pop., 1,020; est., the same.) Incorp. as borough. No sewers or electric lights.

History.—Built by borough, date not given.

Water Supply.—Wells, pumping to tanks.

Pumping Machinery.—Dy. cap., 2,000 galls.

Tanks.—Two: cap., about 20,000 and 8,000 galls.

Distribution.—*Mains*, c. i., 1 mile. *Services*, not given. *Taps* (in '87), 20. *Meters*, not given. *Hydrants*, Ludlow, 4.

Consumption, 1,500 galls. *Pressure*, 75 lbs.

Financial.—Cost, $2,000. Debt, none. Ann. op. exp., $300. Ann. rev.: consumers, $300.

Management—Secy., N. N. Booth. Supt., Smith D. Corsett.

LANCASTER, *Lancaster Co.* (Pop., 25,769; est., 32,000.) On Conestoga creek, on undulating ground rising 100 ft. above stream. Has manufactories. Settled in 1718 as Hickorytown; name was changed to Lancaster in 1730; incorp. a borough in 1742; a city in '30. Has sewers and electric lights.

History.—Built in '36 by borough. Engr., Frederick Erdman. In '87-8 pumping station was moved further up creek to obtain supply uncontaminated with sewage, and other improvements made. Des. Engr., J. J. R. Croes, N. Y. City. Const. Engr., S. M. Slaymaker.

Water Supply.—Conestoga creek, pumping to reservoir. For old works a crib and stone dam formed a storage reservoir and furnished water-power for pumping.

Intake Conduit.—Is 8½ ft. wide, 9½ ft. deep; ends in screen-well.

Pumping Machinery.—Combined dy. cap., 11,000,000 galls.; 5,000,000 and 6,000,000 Worthington; former added in '78 and increased from 3,000,000 to 5,000,000 galls. by enlarging cylinder; latter added in '84. *Boilers:* four, 104-H. P. Babcock & Wilcox sectional tubular.

Old Pumps: first were double set of upright plunger, 30-in. stroke, three pumps in each set, driven by water-wheel; later, horizontal Rush & Muhlenberg and a 500,000 high-pressure Worthington steam pump were added.

Distributing Reservoirs.—Cap., 6,000,000 galls.; 200 ft. above, 4,864 ft. from pumps, in excavation and embankment.

Stand-Pipe.—Cap., 6,000 galls.; 5 x 40 ft.; erected for high service supply.

Distribution.—*Mains*, c. i., 33½ miles. *Services*. w. i., lead. Pipe and specials for the new work from Warren Foundry & Machine Co., Phillipsburgh, N. J., and pipe laid by Davis Ritch & F. Hinden. *Taps*, 5,350. *Meters* (in '87), 10. *Hydrants*, Mathews, Galvin, Bailey and an old style, 400.

Consumption. 4,500,000 galls. *Pressure*, 28 lbs.

Financial.—Cost, $620,000. Debt, $300,000. Int., 4, 5 and 6%. Ann. op. exp., $13,000. Ann. rev.: consumers, $58,000; city, none. Original cost, $150,000.

Management.—Com. of three. Secy., Jacob Halbach. Supt., Edw. F. Frailey.

LANGHORNE, *Bucks Co.* (Pop., 558; est., 1,250.) In farming district. Has electric lights.

History.—Built in '86-7 by Langhorne Spring Water Co. Engr., J. J. DeKinder, Philadelphia. Contr. for masonry, Thos. Gannon.

Water Supply.—Springs, pumping from collecting reservoir to tank.

Collecting Reservoir.—Cap., 135,000 galls.; 30 ft. sq., 20 ft. deep.

Pumping Machinery.—Cap., 600,000 galls.; Hall.

Tank.—Cap., 40,000 galls.; cedar, on stone tower 27 ft. in diam. at bottom, 23 at top, 70 ft. high.

Distribution.—(In '87.) *Mains*, 6 to 3-in. c. i., about 7 miles. *Services*, galv. i. Pipe and specials from McNeal Pipe & Foundry Co., Burlington, N. J. *Taps*, 129. *Meters*, not given. *Hydrants*, Cassin, 12.

Consumption (in '87), 35,000 galls. *Pressure*, said to be 200 lbs.

Financial.—(In '87.) Cost, $30,000, includes price paid for 38 acres of land about springs. Cap. stock, authorized, $40,000; paid up, $30,000. No debt. Ann. op. exp., $900. Ann. rev.: consumers, $1,500; city, none.

Management.—Supt., Samuel Gallagher.

LANSDALE, *Montgomery Co.* (Pop., 798; est., 1,500.) Is 22 miles from Philadelphia. Has manufactories. Incorp. No sewers or electric lights.

History.—Now owned by borough; built in '72 by Lansdale Water Co.

Water Supply.—Artesian well, pumping to tank.

Pumping Machinery.—Dy, cap., 172,000 galls.

Tank.—Cap., about 58,000 galls.; 10 x 100 ft.

Distribution.—*Mains*, c. i. 2 miles. *Services*, lead. *Taps*, 200. *Meters*, none. *Hydrants*, kind not given, 5.

Consumption, not given. *Pressure*, 50 lbs.

Financial.—Cost, $22,356. Cap. stock, $50,000. Debt (in 84), $5,000. Int., 5%. Ann. op. exp., withheld. est., $600. Ann. rev.: consumers, withheld, est., $2,500.

Management.—Prest., W. D. Heebner. Supt., I. D. Heebner.

LANSFORD, *Carbon Co.* (Pop., 2,206; est., 3,000.) On Panther creek, on irregular ground in a valley of the Lehigh mountains, ranges at this point being 400 to 500 ft. high and about a mile apart. Settled in '47; incorp. a borough in '77. Has electric lights.

History.—Built in '73 by Panther Creek Water Co. Engr., J. C. Rutter.

Water Supply.—Streams on Broad mountain, about 3 miles distant, by gravity from impounding reservoir.

Dam and Impounding Reservoir.—Cap., 500,000 galls.; area, 2 acres; 200 ft. above town. Dam not described.

Distribution.—(In '84.) *Mains*, c. i., 8 miles. *Services*, w. i. *Taps*, 210. *Meters* none. *Hydrants*, kind not given, 3.

Consumption, not given. *Pressure*, 112 lbs.

Financial.—(In '84.) Cost, $52,000. No debt. Ann. op exp., $500. Ann. rev.: consumers, $3,000; city, none.

Management.—Supt., W. D. Zehner.

LATROBE, *Westmoreland Co.* (Pop., 1,815; est., 4,500.) In agricultural, coal and coke region, 41 miles from Pittsburgh. Incorp. No sewers. Has electric lights.

History.—Built in '86 by Latrobe Water Co. Des. Engr., J. H. Harlow, Pittsburgh. Contrs., Gas & Water-Works Construction Co., now Jas. H. Harlow & Co., Pittsburgh.

Water Supply.—Loyalhanna river, filtered to a well, thence by direct pumping.

Pumping Machinery.—Cap., 2,600,000 galls.; two 1,300,000 Wilson & Snyder dup.

Distribution.—*Mains*, c. i., 6 miles. *Services*, lead. Pipe and specials from R. D. Wood & Co., Philadelphia, National Foundry & Pipe Works, Ltd., Scottdale. *Taps*, 150. *Meters*, none. *Hydrants*, Mathews, 43. *Valves*, Eddy.

Consumption, 500,000 galls. *Pressure:* Ordinary, 80 lbs. Fire, 120 lbs.

Financial.—Cost, $110,000. Cap. stock, $150,000. Bonded debt, $30,000. Int., 6 %. Ann. op. exp., $2,000. Ann. rev.: consumers, $7,000; city, $1,900. Hydrant rental, $50 for first 20, $40 for remainder, a 10-years contract.

Management.—Prest., H. L. Donnelly. Secy Treas., and Supt., W. A. Johnston.

LEBANON, *Lebanon Co.* (Pop., 8,778; est., 13,000.) On Quittapahilla creek, on slightly undulating ground in Lebanon valley, between Blue Ridge and Kittatinny mountains. Has large iron works. Settled in 1750; incorp. city in '86. No sewers. Has electric lights.

History.—Built in '72 by borough. Des. Engr., H. P. M. Birkinbine, deceased. Const. Engr., above, at first, then B. B. Lehman, finally Simeon Guilford; last two of Lebanon.

Water Supply.—Hammer creek and feeders, by gravity from impounding reservoirs.

Dams and Reservoirs.—Cap., about 45,000,000 galls. *South Mountain:* cap., about 27,000,000 galls.; area, 8¼ acres, at confluence of headwaters of Hammer creek, about 6 miles S. E., and 80 ft. above town. Dam of gravelly clay, with heart-wall; 590 ft. long, 18 ft. high, above natural surface, extending 4 ft below; water-line about 3 ft. from top; 10 ft. wide on top, about 90 at base. Inner slope, 2 to 1, 12 to 18-in. stone paving; outer, 1½ to 1, unpaved. *Heart-wall:* same material as dam, 4 ft. thick at bottom, 2½ at top. *Spillway:* 30 ft. wide, about 50 ft. from dam, through hard side bank; lined with masonry, free; slope, very slight. *Discharge-pipes:* two 12-in. Very slight permanent leakage. *Catch dam:* gravel, built above main dam for filter. Built in '72. Engrs., see History. Contr., D. F. Minahan. Cost, est., $28,732.

No. 2: cap., 18,000,000 galls.; area, 4 acres. Slightly above on feeder of first. Dam similar to above, but of less height. *Spillway,* cut through rock.

Supply Main.—Diam., 16 ins.; length, 6 miles.

Distribution.—*Mains,* c. i., 24 miles. *Services,* galv. i., lead. *Taps,* 3,000. *Meters,* 24. *Hydrants,* Morris, Tasker & Co.'s., and lately, Ludlow and Eddy, 93. *Valves,* kind, do.

Consumption, 1,000,000 galls. *Pressure,* 50 lbs.

Financial.—Cost (in '87), $252,000. Debt, $130,000. Int., 4 and 5%. Ann. op. exp., $1,200. Ann. rev.: total, $18,000.

Management.—Secy., S. H. Bentz. Supt., R. J. Shirk.

NOTE.—Reports on additional supply were made in '89 by Isaac S. Cassin, Philadelphia, and previously by A. Harvey Tyson, Reading. Mr. Cassin recommended a supply from Big Swatara creek, including subsiding reservoir, pumping plant stand-pipe and reservoir, with necessary force and supply mains. Provision might be made for dy. supply of 4,000,000, 8,000,000 or 12,000,000 galls., either at the start or later. Plan favored for present supply seemed to be a 4,000,000-gall. supply, with 18,000,000-gall. reservoir, without subsiding reservoir. Est. cost, $200,000. See "Report to the Mayor and City Councils on the Water Supply of Lebanon, Pa.," by Isaac S. Cassin, C. E. Dated Jan. 14, '89.

LEECHBURGH, *Armstrong Co.* (Pop., est., 3,000.) On Kiskimetas river. Has sheet-iron mills and steel furnaces.

General Description.—Built in '89 by J. C. Kirkpatrick, A. Hicks and C. C. Campbell. A 1,000,000 Smith & Vaile pump.

LEHIGHTON, *Carbon Co.* (Pop., 1,937; est., 2,500.) On Lehigh river, 4 miles from Mauch Chunk. Has various iron works.

History.—Built in '89 by Lehighton Water Co. Des. Engr., J. Marshall Young, Easton. Const. Engr., H. R. Fehr, Easton. Contrs., Coon & Mooney, Kingston.

Water Supply.—Artesian well, pumping to reservoir.

Pumping Machinery.—No data.

Reservoir.—Cap., 600,000 galls.

Distribution.—*Mains,* 8 to 4-in. c. i., 5¾ miles. *Services,* lead. *Taps,* 112. *Meters,* none. *Hydrants,* Adams, 42.

Pressure, 50 lbs.

Financial.—Cost, $29,000. Cap. stock, authorized and paid up, $20,000. Bonded debt, $9,000. Bonds, authorized, $10,000. Hydrant rental, $25. Prest., J. S. Lentz. Secy., Howard Seaboldt. Date of report, March 22, '90.

LEWISBURGH, *Union Co.* (Pop., 3,080; est., 4,000.) On West branch of Susquehanna river, on nearly level ground. Settled in 1785; incorp. a borough. No sewers or electric lights.

History.—Built in '83 by Lewisburgh Water Co., under direction of Supt. S. D. Bates.

Water Supply.—West branch of Susquehanna river, pumping to stand-pipe.

Dam.—Across river, 4 ft. high, giving a depth at low water of 7 ft. above suction-pipe.

Suction-Pipe.—Extends 550 ft. into river.

Pumping Machinery.—Dy. cap., 2,000,000 galls; Knowles comp., dup., 16 and 10 x 10 x 12 ins.

Force Main.—Rises 140 ft No other data.

Stand-Pipe.—Cap., 110,000 galls.; 12 x 130 ft.

Distribution.—*Mains*, c i., 4.7 miles. *Services*, w. i., galv. i. *Taps*, 251. *Meters*, 3. *Hydrants*, Ludlow, 47. *Valves*, Ludlow.

Consumption, 154,000 galls. *Pressure:* Ordinary. 45 lbs. Fire, 100 lbs.

Financial.—Cost, $38,572. Cap. stock, $32,000. Bonded debt, $4,000. Int., 5%. Ann. op. exp., $1,994. Ann. rev.: consumers, $2,793; city, 1,200. Hydrant rental, $30 each for 45; 5-years contract.

Management.—Prest., W. C. Duncan. Secy. and Treas., A. Hayes. Supt., C. Deisbach.

LEWISTOWN, *Mifflin Co.* (Pop., 3,222; est., 3,500.) On Juniata river. Has manufactories.

History.—Probably built in '35 by Lewistown Water-Works Co.

Water Supply.—Springs, by gravity, with emergency pumping station about one mile from village, on Keshacoquiltses creek; also two 300-ft. artesian wells, sunk in '88 or '89, by pumping. Change in system projected for '90.

Pumping Machinery.—No data.

Reservoir.—Cap., about 500,000 galls.

Distribution.—*Mains*, 8 to 4-in. c. i., 3½ miles. *Services*, lead, iron. *Taps*, withheld, est., 150. *Meters*, none. *Hydrants*, Ludlow and others, 30.

Consumption, unknown. *Pressure*, not given.

Financial.—Cost, about $30,000. Cap. stock, $22,000. Debt, none. Ann. op. exp., $2,000. Ann. rev.: consumers, $3,600; city, none.

Management.—Prest., R. H. Lee. Secy., Gen. T. F. McCoy. Treas., Geo. L. Russell. Mgr., C. A. Zerbe.

LEWISVILLE, *Potter Co.* P. O. Ulysses, which see.

LITITZ, *Lancaster Co.* (Pop., est., 2,000.) Mainly engaged in mechanical pursuits.

General Description.—Small system used only for street sprinkling, built by Lititz Water Co., date not given. Water pumped from Lititz springs to an iron tank of 9,375 galls. cap. Pump has dy. cap. of about 10,000 galls. Cap. stock, $1,000. Prest., Isaac F. Bomberger. Treas., Martin Miller. Secy., Johnson Miller.

LOCK HAVEN, *Clinton Co.* (Pop., 5,845; est., 7,500.) On West branch of Susquehanna river. Engaged in manufacturing and lumber trade. Settled in '33; incorp. city in '70. Has electric lights.

History.—Built in '69 by town. Des. Engr., Phaon Jarett. Const. Engr., A. J. Bigony. Contrs., George Armstrong and Lambert Shield & Co.

Water Supply.—Two mountain streams, by gravity from impounding reservoirs on each. Drainage area, 15 sq. m.

Reservoirs.—Cap., 6,000,000 galls.; two, 183 ft. above city, formed by dams. Dams burst May 30, '89; have been repaired.

Distribution.—*Mains*, c. i., 15 miles; first were w. i. and cem., but they were a failure. *Services*, galv. i. In '81 lightning struck a house, followed service pipe to a 4-in. main, and destroyed 400 ft. of latter. *Taps* (in '87), 750. *Meters*, none. *Hydrants*, Holly, 80.

Consumption, not given. *Pressure*, 77 lbs.

Financial.—Cost (in '82), $130,000. Bonded debt (in '87), $114,000. Ann. op. exp. (in '87), $1,400. Ann. rev.: consumers, $10,000; city, none.

Management.—Com. of three from City Council. Secy., S. M. McCormick. Supt. Jno. F. Griffin.

LOCUST MOUNTAIN WATER CO.'S PLANT, *Columbia Co.* Works are 3 miles from Centralia.

History.—Built in '82-4 to supply Mt. Carmel and Centralia in dry season, and also Northern Central R. R. Co., Lehigh Valley R. R. Co., and Collieries. Engr., Thos. S. McNair, Hazleton.

Water Supply.—Roaring creek, pumping to reservoir.

Storage Reservoir.—Cap., 36,375,000 galls.

Pumping Machinery.—Dy. cap., 4,800,000 galls.; two, 2,400,000-gall. Worthington comp.

Distributing Reservoir.—Cap., 2,000,000 galls.

Distribution.—*Mains*, 18 to 4-in. c. i., 15 miles. *Taps*, 15. *Meters*, from National Water Meter Co., 15. *Hydrants*, none.

Consumption, about 112,000 galls

Management.—Prest., Jas. T. Blakslee. Supt., Chas. A. Blakslee, Mauch Chunk.

LYKENS, *Dauphin Co.* (Pop., 2,154; est., 2,800.) In coal region, and furnishes supplies for same.

History.—Built in '85 by Lykens Water Co. Also supplies Wiconisco.

Water Supply.—Rattling creek, by gravity.

Distribution.—(In '87.) *Mains*, c. i., 5 miles. *Services*, not given. Pipe and specials, Warren Foundry & Machine Co., Phillipsburgh, N. J. *Taps*, 114. *Meters*, none. *Hydrants*, Ludlow, 26. *Valves*, Ludlow.

Consumption and *Pressure*, not given.

Financial.—Cost, withheld, est., $55,000. Cap. stock, $35,000. No debt. Ann. op. exp., withheld, est., $800. Ann. rev.: consumers, withheld, est., $5,000.

Management.—Prest., I. J. Wistar. Secy., Horace Whiteman, 233 South 4th St., Philadelphia. Treas., Arthur Haviland. Supt., J. M. Williams.

McKEESPORT, *Allegheny Co.* (Pop., 8,212; est., 22,000.) At junction of Monongahela and Youghiogheny rivers, 752 ft. above sea, on hilly ground rising to height of 300 ft. above rivers. Manufactures steel, w. i. pipe, sheet-iron. Settled in 1795; incorp. borough in '42; and its limits were extended '47 and '73. Has sewers and electric lights.

History.—Built in '81-2 by borough. Engrs., Hatch & Taylor, McKeesport. Contrs., R. D. Wood & Co., Philadelphia.

Water Supply.—Youghiogheny river, pumping to reservoir. Well was dug on the bank of river, 28 ft. in diam., 32 ft. deep, in bottom of which 36 perforated 4-in. c. i. pipes are driven 10 ft. into saturated gravel. A 20-in. c. i. pipe connected well with engine-house.

Pumping Machinery.—Dy. cap., 8,000,000 galls.; two 1,500,000-gall. Worthington dup., high-pressure, and 5,000,000 pump erected in '88. Natural gas is used for fuel. A 1-in. pipe leads from the surface of the reservoir to the engine-house. When reservoir is full water flows through pipe, and by automatic arrangement blows steam whistle as signal to stop pumps.

Force Main.—To reservoir, 1,547 ft. of 16-in. pipe, rising 310 ft. from river.

Reservoir.—Cap., about 6,000,000 galls; in excavation and embankment, 210 ft. sq. x 20 ft. deep to water line. Bottom covered with 6 ins. of concrete on 12 ins. of puddle, and slopes with 10 ins. of stone blocks in cement on 8 ins. of broken stone, the latter being on 12 ins. of puddle.

Distribution.—(Feb. 28, '89.) *Mains*, c. i., 18¼ miles. *Services*, lead. *Taps*, 1,735. *Meters*, 198. *Hydrants*, Mathews, 130.

Consumption, 1,600,000 galls. *Pressure*, 115 lbs.

Financial.—(Feb. 28, '89.) Cost, $200,059. Bonded debt, $125,809: $23,809 at 6; $102,000 at 5%. Sinking fund, $15,000. Ann. op. exp., $6,500. Ann. rev.; consumers, $19,089; city, none.

Management.—Com. of three. Supt., Jos. Ecoff.

NOTE.—May, '89, high service plant was projected for construction in '89-90, consisting of two 1,500,000 pumps at present reservoir, and stand-pipe; latter 20 x 160 ft., with top 212 ft. above reservoir and 517 ft. above pumps.

MAHANOY CITY, *Schuylkill Co.* (Pop., 7,181; est., 11,000.) On Mahanoy creek, at its junction with another small stream, in a mountainous region. Has potteries, iron foundries, and handles coal. Settled in '60; incorp. in '61. Has sewers and electric lights.

History.—Built in '68 by Mahanoy City Water Co., under direction of E. S. Silliman, Prest.

Water Supply.—Springs, and stream on Mahanoy Mt., by gravity from impounding reservoirs. Drainage area, 5 sq. m.

Dams and Reservoirs.--Cap., 45,000,000 galls.; area, over 55 acres; four storage and two feed. Dams Nos. 1 to 4, all clay; well puddled, no heart-walls. Inner slopes paved; outer covered with large stone. Spillways excavated in earth. Nos. 1 to 3 lined with stone. *No.* 1: 500 ft. long, 25 ft. high, 22 ft. water; 30 ft. wide on top, 125 at bottom; 10-in. discharge-pipe, with valve at each end. *No.* 2: 18 ft. water; 25 ft. wide on top, 130 at bottom; 6-in. discharge-pipe, valve at each end. *No.* 3: length not given, 20 ft. high, 16 ft. water; 20 ft. wide on top, 135 at bottom; two 6-in. discharge-pipes, valve at outer ends. *No.* 4: floods 15 acres; 880 ft. long, 35 ft. high, 27 to 29 ft. water; 30 ft. wide at top, 149 at bottom; 10-in. discharge-pipe, valve at lower end. Has wall of large stone at foot of lower slope. Built in '87. Engr. for all dams, see History.

Supply Mains.—Two, leading from different sources; 10 and 6-in., connected at various points.

Distribution.—*Mains*, c. i., 7 miles. *Services*, c. i. *Taps*, 1,500. *Meters*, none. *Hydrants*, Snell & Adams, 26. *Close of* '70: Mains, 4½ miles. Taps, 1,100. Hydrants, 15. *Close of* '80: Mains, 6 miles. Taps, 1,350. Hydrants, 20.

Consumption, 400,000 galls. *Pressure*, 60 lbs.

Financial.—Cost, $120,000. Cap. stock, about $100,000. Debt, $15,800. Int., 5%. Ann. op. exp., $3,250. Ann. rev.: consumers, $14,000; city, $100. Hydrant rental, $4. Cost, close of '70, $89,000; do., '80, $100,000. Rev., '70, $10,000. Do., '80, $12,000.

Management.—Prest., E. S. Silliman. Secy., Henry M. Parmley. Treas., Thos. J. Parmley. Supt., E. Silliman, Jr.

MANHEIM, *Lancaster Co.* (Pop., 1,666; est., 2,300.) In farming and iron mining region; manufactures cigars. Incorp. No sewers or electric lights.

History.—Built in '85 by Manheim Water Co. Engr. and Contr., A. Harvey Tyson, Reading. Sub-contrs. for masonry, L. Barthold & Co.

Water Supply.—Lehman's creek, fed by springs, pumping to reservoir.

Pumping Machinery.—Dy. cap., 600,000 galls.; Worthington.

Reservoir.--Cap., 800,000 galls.

Distribution.—*Mains*, c. i., 4½ miles. *Services*, galv. i., black i. Pipe and specials from Mellert Foundry & Machine Co., Reading. Trenching done by Maginnis & White, Manheim; pipe laid by Mengel, Reading. *Taps*, 182. *Meters*, none. *Hydrants*, Tamaqua. 58. *Valves*, Mellert & Co.'s.

Consumption, 200,000 galls. *Pressure*, 60 lbs.

Financial.—Cost, $28,000. Cap. stock, $28,000. No debt. Sinking fund, $1,412. Ann. op. exp., $1,018. Ann. rev.: consumers, $1,513; city, $600. Hydrant rental, $10.34; borough owns five hydrants

Management.—Prest., A. Kline. Secy., B. H. Hershey. Treas., Geo. H. Danner. Supt., Harry Gyer.

MANOR, *Westmoreland Co.* See Greensburgh.

MAUCH CHUNK and EAST MAUCH CHUNK, *Carbon Co.* (Pop.: Mauch Chunk, 3,752; est., 5,000. East Mauch Chunk, 1,853.) On steep hills, on opposite sides Lehigh river. Center of coal trade. Not incorp. No sewers. Has electric lights.

History.—Built in '49 by Mauch Chunk Water Co. In '61 domestic supply was introduced in E. Mauch Chunk. There is system in each town, but data is not given separately except for water supply. Engr. of original works, E. A. Douglas.

Water Supply.—Springs, by gravity from small impounding reservoirs, two for each town. Works built in '49 took supply from springs, through 4,500 ft. of a 3-in. wooden pipe, to a small reservoir 143 ft. above, and 4,500 ft. from center of town. In '55 additional springs were collected in reservoir and a 6-in. c. i. pipe substituted for wooden one. Supply for E. Mauch Chunk in '61 was from a stream one mile from, and 80 ft. above, town.

Impounding Reservoirs.—See above. No further data.

Distribution.—*Mains*, c. i., 4 miles. *Services*, lead. *Taps*, 520. *Meters*, 4. *Hydrants*, Mathews, 25, in Mauch Chunk. *Valves*, Ross.

Consumption, unknown. *Pressure*, 80 lbs.

Financial.—Cost, $37,500. Cap. stock, $37,500. No debt. Ann. op. exp., $1,000. Ann. rev.: consumers, $5,000; city, none. Hydrant rental, free.

Management.—Prest., Robt. Klotz. Secy., S. S. Smith. Treas., C. O. S Keer.

MEADVILLE, *Crawford Co.* (Pop., 8,860; est., 10,000.) On French creek, chiefly in valley, about one-third being on rising ground. Has flouring, silk and nail mills, glass factories, tanneries, machine shops and iron foundries. Settled in 1788; incorp. borough in '23; city in '65. Partially sewered. Has electric lights.

History.—Built in '74-5 by Meadville Water Co. Engr., Robt. Cartwright.

Water Supply.—French creek, pumping to reservoir.

Filter and Pump-Well.—Latter 35 ft. in diam., bottom on a level with deepest part of creek; dry stone walls; is 24 ft. from the river and connected with it by a gravel-filled trench, which acts as a filter. Gravel renewed once in 4 years.

Pumping Machinery.—Dy. cap., 5,000,000 galls.; 1,500,000 Lang water-power, 12½ x 30 ins., erected in '80; 3,500,000 Knowles water-power, added in '81. First pump erected was Flander's water-power. 11 x 16 ins., driven by American turbine under a head of 15 ft., giving 109 H. P.

Force Main.—Rises 285 ft.; 4,400 ft. of 12-in. c. i.

Reservoir.—Cap., 5,000,000 galls.; on slightly sloping surface, in excavation and embankment, 285 x 150 ft. at top, 24 ft. deep; has division wall 10 ft. high. Banks 9 ft. wide on top, slopes 1¾ to 1. Bottom and inner slopes have 12 ins. of puddle, over which is 1 in. of gravel, then brick paving grouted with cement.

Distribution.—*Mains*, c. i., 18.84 miles. *Services*, galv. i., enam. i. *Taps*, 1,142. *Meters*, 36. *Hydrants*, Mathews, 105. *Valves*, Eddy.

Consumption, 734,520 galls. *Pressure*, 115 lbs.

Financial.—Cost, $174,359. Cap. stock, $150,000. Debt, $10,000. Int., 5%. Sinking fund, $24,359. Ann. op. exp., $5,634. Ann. rev.: consumers, $17,070; city, $5,250. Hydrant rental, $50, a 10-years contract.

Management.—Prest., J. D. Gill. Secy., E. Hindekoper. Treas., Saml. B. Dick Supt., Geo. S. Cullum.

MECHANICSBURGH, *Cumberland Co.* (Pop., 3,018; est., 4,000.) Is 8 miles from Harrisburgh, in broken agricultural and iron ore district. Incorp. borough in '26. Has sewers. No electric lights.

History.—Built in '57-8 by Mechanicsburgh Gas & Water Co. Engrs. and Contrs., Irish & Quinn.

Water Supply.—Spring, by gravity from receiving and distributing reservoirs. One spring is in limestone, others in slate. Water from various springs is collected by 1½ miles of tile pipe. A 6-in. artesian well, 660 ft. deep has been sunk at collecting reservoir; dy. cap., natural flow, about 1,500 galls.; by pumping, about 75,000 galls.

Receiving Reservoir.—Cap., about 650,000 galls.; 275 x 85 ft., x 4 ft. deep. Slopes lined with oak plank. At outlet water passes through 5 sheets of galv. i., 2 x 4 ft., perforated with ½-in. holes; sheets 15 ins. apart in a wooden trough.

Tunnel and Conduit.—From strainers water passes for 700 ft. through tunnel in slate rock 4 x 6 ft., then through 600 ft. of 6-in. c. i. pipe, fitted with a strainer to distributing reservoir.

Distributing Reservoir.—Cap., about 1,200,000 galls.; 85 x 200 ft., x 10 ft. deep. Slopes lined with 18 ins. stone in cem. *Discharge-pipes:* two, each 6-in., one c. i., one wood.

Supply Main.—Is 2½ miles long, has fall of 76 ft.; 6-in., with 1,000 ft. replaced by 10-in.

Distribution.—*Mains*, c. i., about 4 miles. *Services*, galv. i. *Taps*, 600. *Meters*, none. *Hydrants*, kind not given, 28.

Consumption, 74,000 galls. *Pressure*, 32 lbs.

Financial.—Cost, $68,000. Debt, $34,000. Int., 5%. Ann. op. exp., $3,400. Ann. rev.: consumers, $4,000; city, $400.

Management.—Prest., Jos. Lear. Treas., J. C. Bauman. Supt., Andrew Seifert.

MEDIA, *Delaware Co.* (Pop., 1,919; est., 3,000.) Is 12 miles from Philadelphia. Has electric lights.

History.—Built in '71 by borough. Engr., Isaac S. Cassin, Philadelphia. Work done by day.

Water Supply.—Ridley creek, pumping to reservoir.

Pumping Machinery.—Dy. cap., 1,400,000 galls.; 1,000,000 Worthington water-power; 400,000 gall. Knowles steam pump. *Water-wheels:* two Leffel turbines.

Reservoir.—Cap., 1,250,000 galls.

Distribution.—(In '87.) *Mains*, c. i., 6.6 miles. *Services*, lead. Pipe and special from Mellert Foundry and Machine Co., Reading. *Taps*, about 400. *Meters*, none. *Hydrants*, about 75; Cassin, Mathews. *Valves*, kind, do.

Consumption (in '87), 150,000 galls.

Financial.—(In '87.) Cost, about $80,000. Debt (in '82), $65,000. Int., 4%. Ann. op. exp., $1,000. Ann. rev.: consumers, $5,500; city, none.

Management.—Borough Council. Supt., Ralph Buckley.

MERCER, *Mercer Co.* (Pop., 2,344; est., 2,500.) On Neshannock creek, in agricultural, grazing and mining region. Has iron manufactories. Incorp. Partially sewered. No electric lights.

History.—Built in '87 by Mercer Water Co. under a 10-years franchise. Const. Engr. and Contr., Jas. H. Harlow, Pittsburgh. Rest. Engr., C. D. Barstow.

Water Supply.—Otter creek, filtered, pumping to tank, with direct pumping in case of fire. Supply taken about 2 miles below source of creek.

Filter and Pump-Well.—Water passes through filter to pump-well sunk 8 ft. in gravel near stream.

Pumping Machinery.—Dy. cap , 2,100,000 galls.: 600,000 and 1,500,000 Smith & Vaile, latter added in '89. *Boilers:* old, 50-H. P.; new, no data.

Force Main.—C. i., 6-in., one mile long; rise, 200 ft.

Tank.—Cap., 67,000 galls.; 24 x 20 ft., iron, on 60-ft. iron trestle.

Distribution.—*Mains*, c. i., 3 miles. *Services*, w. i. *Taps*, 250. *Meters*, none. *Hydrants*, Ludlow, 24.

Consumption, 300,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 125 lbs.

Financial.—Cost, $22,000. Cap. stock, $12,000. Bonded debt, $12,000. Int., 6%. Ann. op. exp., $1,000. Ann. rev.: consumers, $2,000; city, $840. Hydrant rental, $35.

Management.—Prest., S. H. Miller. Secy. and Treas., Henry Robinson. Supt., Louis M. Hamerer.

MESHOPPEN, *Wyoming Co.* (Pop., 551; est., 800.) Incorp. No sewers or electric lights.

History.—Built in '73 by Meshoppen Borough Water Co.

Water Supply.—Springs and brook, by gravity.

Reservoirs.—Cap., 63,000 galls. One 30 ft. sq. x 8 ft. deep, one 12 x 20 ft., x 5 ft. deep.

Distribution.—*Mains*, iron, 3 miles. *Services*, iron. *Taps*, 100. *Meters*, none. *Hydrants*, from Pancoast & Maule, Philadelphia, 2. Practically same as when finished, in '73.

Consumption, 5,000 galls. *Pressure*, about 100 ft. head.

Financial.—Cost, about $10,000. Cap. stock, $4,000. No debt. Ann. op. exp., $100. Ann. rev.: consumers, $600; city, none.

Management.—Prest., E. H. Wells. Secy., N. A. Wells. Treas., A. H. Sterling.

MEYERSDALE, *Somerset Co.* (Pop., 1,423; est., 1,700.) Has manufacturing, mining and lumber interests. Incorp. No sewers or electric lights.

History.—Built in '88 by Sand Spring Water Co. Engr., G. L. Benford. Contr., J. S. Graves, Meyersdale. Sub-contr. for masonry, Jno. Porter.

Water Supply.—Sand spring, by gravity.

Reservoir.—Cap., 1,000,000 galls.

Distribution.—*Mains*, c. i., 4 miles. *Services*, not given. *Taps*, 138. *Meters*, none. *Hydrants*, 22.

Consumption, unknown. *Pressure*, 110 lbs.

Financial.—Cost, about $17,000. Cap. stock, $10,500. Debt, $2,750. Int., 5%. No bonds. Ann. op. exp., est., $250. Ann. rev.: consumers, about $1,000; city, $600. Hydrant rental, $30.

Management.—Prest., A. Chamberlain. Secy., S. B. Philson. Treas., W. B. Cook. Supt., J. S. Graves.

MIDDLETOWN, *Dauphin Co.* (Pop., 3,350; est. 5,500.) On Susquehanna river, 9 miles from Harrisburg. Has manufacturing and lumber industries. Incorp. No sewers or electric lights.

History.—Built in '85 by Middletown Water Co. No Engr. Contr., M. Mahony, Middletown, who sublet masonry and buildings to local parties. Prest. and Treas. own ¾ of stock.

Water Supply.—Swatara creek, pumping to stand-pipe.

Pumping Machinery.—Dy.cap.,230,000 galls.; water-power pump made by Raymond & Campbell, Middletown.

Stand-Pipe.—Cap., 210,000 galls.; 16x140 ft.; made by Raymond & Campbell, Middletown.

Distribution.—*Mains*, c. i., 5 miles. *Services*, not given. Pipe and specials from R. D. Wood & Co., Philadelphia. *Taps*, 257. *Meters*, 2. *Hydrants*, Mathews, 37.

Consumption, 125,000 galls. *Pressure*, 60 lbs.

Financial.—Cost, $57,000. Cap. stock, $50,000. Bonded debt, $25,000. Int., 6%. Ann. op. exp., about $500. Ann. rev.: consumers, $3,600; city, $1,597. Hydrant rental, $50.

Management.—Prest., Jos. Campbell. Treas., C. W. Raymond.

MILFORD, *Pike Co.* (Pop., 983; est., 1,000.) On Delaware river, about midway between N. Y. City and Philadelphia. A summer resort. Incorp. No sewers or electric lights.

History.—Built in '66 by Milford Water Co., under perpetual charter.

Water Supply.—Spring, by gravity.

Distribution.—*Mains*, iron, 3 miles. *Services*, iron, lead. *Taps*, 90. *Meters*, none. *Hydrants*, kind not given, 21.

Consumption, unknown. *Pressure*, 65 lbs.

Financial.—Cost, $16,500. Cap. stock, $12,000. No debt. Ann. op. exp., $75. Ann. rev.: consumers, $800.

Management.—Prest., J. C. Wallace. Secy., Chas. P. Mott. Treas., J. H. Van Etten. Supt., Milton Armstrong.

MILLERSTOWN, (*Barnhart's Mills P. O.*) *Butler Co.* (Pop., 1,108; est., 2,000.) In coal and oil region. Has machine and boiler shops.

History.—Built in '74 and owned jointly by borough and H. A. Leopold, the latter owning 1 mile of pipe and having use of water free, presumably for manufacturing purposes, for making repairs.

Water Supply.—Artesian well, pumping to tanks.

Pumping Machinery.—Dy. cap., 75,000 galls.; kind not given.

Tanks.—Two for village, combined cap., 28,000 galls. In addition, H. A. Leopold has tanks with cap. of 64,000 galls.

Distribution.—*Mains*, kind not given, 1 mile. *Services*, not given. *Taps*, 150. *Meters*, none. *Hydrants*, kind not given, 11.

Consumption, 40,000 galls. *Pressure:* Ordinary, 10 to 80 lbs. Fire, 30 to 90 lbs.

Financial.—Cost, withheld, est., $8,000. Debt, $600. Int., 6%. Ann. op. exp., $1,500. Ann. rev.: consumers, $2,000; city, $600.

Management.—H. A. Leopold.

MILTON, *Northumberland Co.* (Pop., 2,102; est., 5,500.) On west branch of Susquehanna river. Manufactures iron and steel, cars, nails, axles and hoops. Settled in 1790; incorp. borough in '14. Incorporated. Partially sewered. No electric lights.

History.—Built in '83 by Milton Water Co. Engr., Geo. H. Pierson.

Water Supply.—West branch of Susquehanna river, pumping to reservoir.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; Worthington.

Reservoir.—Cap., 2,000,000 galls.; excavated in red sandstone, lined with stone paving on clay puddle, 286 x 100 ft.

Distribution.—*Mains*, c. i., 7 miles. *Services*, galv. i. *Taps*, 400. *Meters*, 2, *Hydrants*, Ludlow, 41. *Valves*, Eddy.

Consumption, 3,000,000 galls. *Pressure:* Ordinary, 58 lbs. Fire, 100 lbs.

Financial.—Cost, $50,000. Cap. stock issued, $42,000. Bonded debt, $6,000. Int., 5%. Ann. op. exp., $2,700. Ann. rev.: consumers, $5,200; city, none. Hydrant rental, contract expired and has not been renewed.

Management.—Prest. and Supt., R. F. Wilson. Secy. and Treas., H. R. Frick.

MINERSVILLE, *Schuylkill Co.* (Pop., 3,249; est., 4,000.) Is 4 miles from Pottsville; engaged in coal mining. Incorp. borough. No sewers. Electric lights built in '89.

History.—Built in '57-61 by Minersville Water Co. Des. Engr., Saml. Lewis. Const. Engrs. and Contrs., Miller & Burket, both deceased.

Water Supply.—Mountain springs, by gravity.

Reservoir.—Cap., not given; area, 1½ acres.

Distribution.—*Mains*, 8-in. c. i., 9 miles. *Services*, lead. Pipe and specials from R. D. Wood & Co., Philadelphia. *Taps*, 350. *Meters*, 2. *Hydrants*, Mathews, 30. *Valves*, Eddy.

Consumption, 120,000 galls. *Pressure*, 100 lbs.

Financial.—Cost, about $40,000. Cap. stock, $60,000. No debt. Ann. op. exp., $1,500. Ann. rev.: consumers, about $6,500; city, none.

Management.—Prest., R. F. Potter. Secy. and Supt., Chas. R. Kear. Treas., J. S. Lawrence.

MINOOKA, *Lackawanna Co* (Pop., to be supplied, est.: Minooka, 2,000; Taylorville, 4,000; Bellevue, 2,200; part of Scranton, 1,500; total, 9,700.) Near Scranton.

History.—Built in '88 under 4 charters: Minooka, Taylorville, Bellevue and People's (of Scranton) Water Cos. Des. Engr., W. M. Marble. No Const. Engr. Contr., B. F. Filman, Scranton.

Water Supply.—Cold Spring reservoir, by gravity.

Reservoir.—Area, about 23 acres; depth, av., 15 to 20 ft. Labor done by the day.

Filter.—Stone and gravel.

Distribution.—*Mains*, 16 to 3-in. c. i., 20 miles. *Services*, galv. i., lead. Pipe and specials from Jackson & Woodin Mfg. Co., Berwick; specials from Warren Foundry & Machine Co., Phillipsburgh, N. J. *Taps*, 500. *Meters*, Crown, 2. *Hydrants*, Ludlow, number not given. *Valves*, Ludlow.

Consumption, unknown. *Pressure*, 85 to 200 lbs.

Financial.—Cost, $30,000. Cap. stock, withheld. No bonds or debt. Ann. op. exp., $400. Ann. rev.: consumers, $3,687; city, withheld. Hydrant rental, $25.

Management.—Prest., Lemuel Amerman. Secy. and Treas., L. A. Waters. Supt., Wm. P. Kelley. All of Scranton.

NOTE.—There is a seeming discrepancy between cost of works and extent of distribution, as reported and given. Date of report, March 5, '90.

MONONGAHELA CITY, *Washington Co.* (Pop., 2,904; est., 4,000.) On Monongahela river, 31 miles south of Pittsburgh. Engaged in mining and manufacturing, and has oil and natural gas deposits. Incorp. Has sewers and electric lights.

History.—Built in '88-9 by Monongahela City Water Co., which is controlled by the Kittaning Consolidated Water Cos., of Kittaning; put in operation late in '89. Engr., Robt. H. Wilson, Saltsburgh.

Water Supply.—Monongahela river, pumping from filter-well to reservoir.

Filter-Well.—About 125 ft. from low-water mark of river, in gravel, 20 ft. in diam., carried 10 ft. below river-bottom. Water stands at level of river.

Pumping Machinery.—Dy. cap., 1,000,000 galls. Holly dup., high-pressure, 16 x 10 x 12 ins.; inside packed plunger. *Boiler:* 5 x 16 ft., horizontal; from Russel & Co., Massilon, O.

Force Main —C. i., 10-in., 2,550 ft. long.

Reservoir.—Cap., 1,600,000 galls.; in excavation and embankment, 282 ft. above low-water in river; 83 x 105 ft. on bottom, 15 ft. deep. Banks, 16 ft. wide on top; both slopes 1¾ to 1; inner slope and bottom lined with 20 ins. puddled clay, then paved with hard brick on edge in cem. mortar (1 part cem., 2 sand), then grouted. But little leakage during first three weeks after filling. Contr., C. S. Coon, Monongahela City.

Distribution.—*Mains*, 10 to 4-in. c. i., 9 miles. *Services*, not given. Pipe and specials from Jackson & Woodin Mfg. Co., Berwick. *Taps* and *Meters*, not decided. *Hydrants*, 20.

Consumption, not determined. *Pressure:* Ordinary, 70 lbs. Fire, 90 lbs.

Financial.—Cost, to Jan. 1, '89, $63,000; when completed, about $90,000. Cap. stock, $130,000. Bonded debt, $30,000. Int., 6%. Ann. op. exp., and ann. rev., not determined. Hydrant rental, $50 each for 20; 10-years contract.

Management.—Prest. V. Neubert. Secy. and Supt., Geo. H. Fox, Kittaning. Treas., Wm. Pollock.

MOOSIC, *Lackawanna Co.* (Pop., est., 5,000.)

History.—Built in '86-7 by Spring Brook Water Co., without Engr. Charter covers Avoca, otherwise known as Pleasant Valley. Co. has leased small system of Moosic Water Co., which is included below.

Water Supply.—Spring brook, pumping to reservoir.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; from W. F. Mattes, Scranton.

Reservoir.—Cap., 1,250,000 galls. Contr., Geo. B. Foster, Duryea.

Distribution.—*Mains*, 12 to 4-in. iron, 12 miles. *Services*, galv. i. Pipe and specials from Jackson & Woodin Mfg. Co., Berwick, and Warren Foundry & Machine Co., Phillipsburgh, N. J. *Taps*, 375. *Meters*, 2. *Hydrants*, Tamaqua, 8. *Valves*, Eddy.

Consumption, 500,000 galls. *Pressure*, 70 to 110 lbs.

Financial.—Cost. $54,000. Cap. stock, paid up, $30,000; authorized, $50,000. Bonded debt, $15,000. Int., 6%. Ann. op. exp., $1,700. Ann. rev.: consumers, $6,620; city, $280. Hydrant rental, $35 each.

Management.—Prest., L. D. Shoemaker, Wilkes-Barre. Secy., L. A. Waters, Scranton. Treas., Abram Nesbitt, Kingston. Supt., Wm. Monie, Moosic.

NOTE.—Above given latter part of '88 or early in '89. In '89 Co. was reorganized, as given under Management, and works extended to supply several towns by laying 9 miles 24-in., 6 of 20, and 4 of 10-in. pipe, [Name of Co. and officers same as at Kingston, which see.]

MOUNT CARMEL, *Northumberland Co.* (Pop., 2,378; est., 4,500.) Has extensive anthracite coal collieries.

History.—Built in '85 by Mount Carmel Water Co. Des. Eng., A. B. Cochran.

Water Supply.—Springs, by gravity; see Locust Mountain Water Co.

Reservoirs.—Cap., 5,000,000 galls.; two.

Distribution.—(In '87.) *Mains*, kind not given, 5 miles. *Services*, not given. *Taps*, 500. *Hydrants*, kind not given, 24.

Consumption (In '87), 50,000 galls. *Pressure*, 75 lbs.

Financial.—(In '87.) Cost, $85,000. Cap. stock, $25,000. Debt, $5,625: bonded debt, $5,000; floating, $625. Int., 4%. Ann. op. exp., $500. Ann. rev.: consumers, $4,400; city, $240. Hydrant rental, not given.

Management.—(In '88.) Prest., Wm. Schwenk. Treas., L. W. Johnson. Supt., T. Scott.

NOTE. No reply to inquiries sent in '89.

MOUNT JOY, *Lancaster Co.* (Pop., 2,058; est., 2,200.) Is 12 miles west of Lancaster and 24 east of Harrisburg. Has iron foundry, and manufactures woolen goods and agricultural implements. Incorp. No sewers or electric lights.

History.—Built in '74 by town. Engr., H. P. M. Birkinbine, deceased.

Water Supply.—Chiquesalunga creek, pumping to reservoir, with direct pumping for fire protection.

Pumping Machinery.—Dy. cap., "not known"; Birkinbine and Weiner.

Reservoir.—Cap., 750,000 galls.

Distribution.—*Mains*, c. i., 3.35 miles. *Services*, galv. i., black i. *Taps*, 270. *Meters*, none. *Hydrants*, made by P. Werner, Lebanon, 28.

Consumption, unknown. *Pressure:* Ordinary, 34 lbs. Fire, 45 lbs.

Financial.—Cost, $50,000. Bonded debt, $30,000. Int., 4%. Ann. op. exp., $800. Ann. rev.: consumers, $2,650.

Management.—Town Council. Supt., William Kuhn.

MOUNT PLEASANT, *Westmoreland Co.* (Pop., 1,197; est., 3,800.) In coke region.

History.—Built in '86; ownership not given. Supplies Everett.

Water Supply.—Jacob's creek, pumping to reservoir and stand-pipe.

Pumping Machinery.—Dy. cap., 3,500,000 galls.; 2,500,000 and 1,000,000 Gordon, latter added in '89.

Stand Pipe.—No data.

Reservoir.—No data.

Distribution.—*Mains*, 16 to 4-in., material not given, 7 miles. *Services*, not given. *Taps*, not given, est., 250. *Meters*, not given. *Hydrants*, Galvin, 50. *Valves*, Galvin.

Consumption, not given. *Pressure*, 50 to 100 lbs.

Financial.—No data. *Est.:* cost, $70,000. Ann. op. exp., $2,000. Ann. rev.: total, $5,000.

Management.—Prest., H. C. Frick. Supt., H. Coll

NANTICOKE, *Luzerne Co.* (Pop., 3,884; est., 10,000.) On Susquehanna river, 5 miles from Wilkes-Barre. Has coal mines, drill factory and planing mill.

General Description.—Built [probably] in '85. A 3,000,000-gall. Gordon pump lifts water to stand-pipe. *Mains*, 12 to 4-in., 13 miles. *Hydrants*, 35. Mgr., C. W. Mosley.

NAZARETH, *Northampton Co.* (Pop., 984; est., 1,000.) Incorp. No sewers or electric lights.

History.—Built in '69 by Nazareth Water Co.

Water Supply.—Springs, by gravity and pumping to reservoir.

Pumping Machinery.—Dy. cap., about 125,000 galls.; one Deane steam, and one Manuel wind-mill.

Reservoir.—Cap., 194,000 galls.; 24 x 120 ft., x 9 ft. deep.

Distribution.—*Mains*, 4-in. c. i., 2½ miles. *Services*, ¾-in., kind not given. *Taps*, about 100. *Meters*, none. *Hydrants*, mostly McKean, 19.

Consumption, 15,000 galls. *Pressure*, 60 lbs.

Financial.—Cost, $15,000. Cap. stock, $7,350, at 5%. Total debt, $10,950. Bonded debt, $3,600. Int., 4½%. Ann. op. exp., $250. Ann. rev.: consumers, $650; city, $285. Hydrant rental, $15.

Management.—Prest., H. F. Kingkinger. Secy. and Treas., Frank Kunkle. Supt., John F. Bardill.

NEW BETHLEHEM, *Clarion Co.* (Pop., 773; est., 1,100.) On Red Bank creek, in rough, hilly country. Engaged in coal and lumber business. Incorp. borough in '52. No sewers or electric lights.

History.—Built in '83 by Citizens' Water Co. No Engr. or general Contr.

Water Supply.—Red Bank creek, pumping to reservoir.

Filter.—Water passes to pump through stone, placed in frames 8 ft. sq. and 4 ft. high, made of 2-in. oak plank.

Pumping Machinery.—Dy. cap., 100,000 galls.; 10-in. Worthington.

Reservoir.—Cap., 120,000 galls.; is 32 x 64 ft., x 8 ft. deep, lined with 2-in. white pine plank; 197 ft. above pump, 165 ft. above town.

Distribution.—*Mains*, c. i., 1½ miles. *Services*, galv. i. *Taps*, 50. *Meters*, none. *Hydrants*, Hutchinson & Alexander, 13.

Consumption, 30,000 galls. *Pressure*, 85 lbs.

Financial.—Cost, $11,592. Cap. stock, $10,000. No debt. Ann. op. exp., $600. Ann. rev.: consumers, $1,200; city, $325. Hydrant rental, $25, a 5-years contract.

Management.—Prest., Wm. M. Moore. Secy., E. V. Marsh. Treas., J. R. Foster. Supt., Geo. S. Thomas.

NEW BRIGHTON, *Beaver Co.* (Pop., 3,653; est., 5,000.) On Beaver river, 3 miles from its junction with Ohio, on three terraces each about 100 ft. high. In coal region, and has deposits of clay used for stoneware and terra cotta. Has water-power. Settled about 1800.

History.—Built in '78-9 by New Brighton Water-Works Co. Engr., Jos. Flannery.

Water Supply.—Beaver river, filtered, pumping to reservoir and direct pumping. A caisson was sunk and tightly enclosed to keep out water from sides, supply coming up from bottom.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; 750,000 Worthington water-power; 250,000 Wilson & Snyder steam.

Filter.—Dy. cap., 650,000 galls.; Hyatt; erected Nov., '89.

Reservoir.—Cap., 500,000 galls.; 312 ft. above river.

Distribution.—(In '87.) *Mains*, 12 to 4-in. c. i., 11 miles. *Services*, lead. *Taps*, 350. *Meters*, 4. *Hydrants*, Mathews, 55.

Consumption, (in '87) 300,000 galls. *Pressure*, 110 lbs.

Financial – (In '87.) Cost, $65,000. Bonded debt, $25,000. Int., 6%. Ann. op. exp., $2,800. Ann. rev.: consumers, $4,250; city, $2,250. Hydrant rental, $44 for first 50, $25 for additional.

Management.– (In '88.) Prest., R. S. Kennedy. Secy. and Treas., H. S. McConnel. Supt., Jno. D. King.

NEW CASTLE, *Lawrence Co* (Pop., 8,418; est., 15,000.) At junction of Shenango and Neshannock rivers, the two forming the Beaver. On flat ground, surrounded by high hills. Manufactures iron, glass, sewer-pipe, fire-brick and coke; engaged in mining bituminous coal and iron ore, and in quarrying sandstone and limestone. Settled about 1800; incorp. borough in '25; city in '69. Partially sewered. Has electric lights.

History.—Built in '81 by City of New Castle Water Co Des. Engr., Jas. H. Harlow Contr. for masonry and buildings, A. C. Megoun.

Water Supply.—Shenango river, pumping to reservoir.

Pumping Machinery —Dy. cap., 3,000,000 galls.; Worthington, added in '89. Original pumps, 2,500,000 Blake dup. but as new boilers were not addded with Worthington pump, present cap. is as above.

Reservoir.—Cap., 7,500,000 galls.; in excavation and embankment, 150 x 188 ft. at bottom, 24 ft. deep; 2 miles from, 266 ft. above, city. There is a berme 8 ft. wide at 14 ft. above bottom. Bottom and slopes are covered with 2 ft. of puddle, and above berme the slopes are paved with 15 ins. of dry stone, laid on edge, on 9 ins. of broken stone.

Distribution—*Mains*, c. i., 17 miles. *Services*, lead, kal. i. *Taps*, 700. *Meters*, none. *Hydrants*, Mathews, 116. *Valves*, Eddy.

Consumption, 600,000 galls. *Pressure*, 120 lbs.

Financial.—Cost, withheld, est., $170,000. Cap. stock, $200,000. Bonded debt (in '87), $100,000. Int., not given. Ann. op. exp., $4,800. Ann. rev.: consumers, $14,000; city, $5,600. Hydrant rental, 100 at $50, 16 at $40; 10-years contract.

Management.—Prest., Jesse H. Lippincott. Secy. and Treas., L. H. Williams. Supt., J. W. Taylor.

NEW HAVEN, *Fayette Co.* (Pop., 442.) See Connellsville.

NEWTOWN, *Bucks Co.* (Pop., 1,001; est., 1,400.) In farming district, 10 miles from Trenton, N. J. Incorp. No sewers. Charter granted in '89 for electric light system.

History.—Built in '88-9 by Newtown Artesian Water Co. Engr., M. Van Harlingen, Philadelphia. Contr., Thos. H. Regan, Philadelphia. Sub-contr. for masonry, A. Seagler, Doylestown; buildings, G. B. Girton, Newtown.

Water Supply.—Two artesian wells, pumping to reservoir.

Pumping Machinery.—Dy. cap., 228,000 galls; Downie double-acting artesian well pump. *Boiler:* from J. E. Thropp, Trenton, N. J.

Reservoir.—Cap., 65,000 galls.; 105 ft. sq. at bottom, 12 ft. deep. *Discharge-pipe:* 8-in. Built fall of '89. Engr. and Contr., see History.

Distribution.—*Mains*, 8 to 4-in. c. i., 3½ miles. *Services*, not given. Pipe and specials from Union Hydraulic Co., Philadelphia; trenching sublet to Moore & Jordan, Phœnixville. *Taps*, 71. *Meters*, none. *Hydrants*, Cassin, 22.

Consumption, about 20,000 galls. *Pressure*, 40 lbs.

Financial.—Cost, $23,000. Debt, none. Ann. op. exp. and ann. rev.: nominal for '88. Total rev., *est.*, $1,000. Hydrant rental, $12.50.

Management.—Prest., Geo. C. Worstall. Secy., Paul Blaker. Treas., Harry A. Smith.

NOBLE, *Montgomery Co.* See Jenkintown.

NORRISTOWN, *Montgomery Co.* (Pop., 13,063; est., 16,000.) On Schuylkill river, 16 miles above Philadelphia, on hilly land. Manufactures glass, iron, nails, tacks, cotton and woolen goods, and has large marble and limestone quarries near by. Settled in 1778; incorp. borough in '12. Has sewers and electric lights.

History.—Built in '47 by Norristown Insurance & Water Co. Des. Engr., Wm. E. Morris.

Water Supply.—Schuylkill river, pumping to reservoir. Opposite town an island a mile long divides river in two channels, and water is taken from further one.

Intake Pipe.—Diam., 20 ins.; length, 1,450 ft.

Pumping Machinery.—Dy. cap., 9,000,000 galls.; 5,000,000 Worthington, added in '83, 1,000,000 Worthington dup., double-acting piston pump of 16-in. bore and stroke, built by R. S. Newbold & Son. There has also been connected with works double-acting piston pump of 7¾-in. bore and 60-in. stroke but it is not stated whether this is now in use. New engine house built and three new boilers added in '88.

Reservoir.—Cap., 10,000,000 galls.; 194 ft. above river, in excavation and embankment, in two divisions. Banks 17 ft. high above natural surface, of clay and sand, puddled, without heart-wall; 115 ft. wide on top; trench about 3 ft. deep, dug beneath and nearly as wide as bank, and filled with puddle. Inner slope, 2 to 1, paved with hard brick on edge. *Discharge-pipes:* two 24-in., with bottoms about 6 ft. below natural surface. Also, two inlet pipes. Reservoir does not leak badly. Built in '80. Engr., Jno. Slingluff, Supt.

Distribution.—*Mains*, 24 to 4-in. c. i., 20 miles. *Services*, lead. *Taps*, "unknown," est., 2,000. *Meters*, none. *Hydrants*, various kinds, 175. *Valves*, principally Ludlow.

Consumption, 2,000,000 galls. *Pressure*, 63 lbs.

Financial.—Cost (in '87), $325,000. Cap. stock (in '87), $200,000. Bonded debt (in '87), $90,000. Int., 5%. Ann. op. exp., withheld, est., $6,000. Ann. rev.: consumers, withheld, est., $38,000; city, none. Hydrant rental, free. Prest. and Supt. Jno. Slingluff. Secy., H. S. Sechler. Treas., W. F. Slingluff.

NORTH CLARENDON, *Warren Co.* (Pop., 295.) Incorp. No sewers or electric lights.

History.—Now owned by Elston estate; formerly owned by Brown Bros. Date built not given.

Water Supply.—Artesian well, direct pumping for domestic use; pumping to tank for fire purposes.

Pumping Machinery.—Dy. cap., not given; Guild & Garrison, 10 x 6 x 10 ins.

Tank.—Cap., about 35,000 galls.

Distribution.—*Mains*, w. i., about 1½ miles. *Services*, w. i. *Taps*, about 90. *Meters*, not given, probably none. *Hydrants*, kind not given, 9.

Consumption, not given. *Pressure:* Ordinary, 20 lbs. Fire, 90 lbs.

Financial.—Cost, $4,300. Debt, not given. Ann. op. exp., $1,300. Ann. rev.: consumers, about $1,500; city, not given.

Management.—Supt., A. F. Crossman.

NORTH EAST, *Erie Co.* (Pop., 1,396; est., 1,500.) In dairy and agricultural section, 15 miles from Erie.

History.—Built in '86 by town.

Water Supply.—Springs, by gravity.

Distribution.—*Mains*, c. i., 6 miles. *Services*, galv. i. Pipe from Lake Shore Foundry, Cleveland, O.; specials from Buffalo (N. Y.) C. I. Pipe Co.; trenching and pipe-laying done by Isaac Ackerman, North East. *Taps*, 100. *Meters*, National, 9. *Hydrants*, Ludlow, 34. *Valves*, Ludlow.

Consumption, 50,000 galls. *Pressure*, 100 lbs.

Financial.—Cost, about $20,000. Bonded debt, $20,000. Int., 5%. Ann. op. exp., about $450. Ann. rev.: consumers, about $1,450.

Management.—Burgess, R. A. Davidson. Secy. and Supt., E. W. Merrill.

NORTH WALES, *Montgomery Co.* (Pop., 673; est., 1,500.) Is 18 miles from Philadelphia, in agricultural and manufacturing district. Incorp. borough. No sewers or electric lights.

History.—Built in '86-8 by North Wales Water Co.; put in operation July, '88. No Engr.

Water Supply.—Two artesian wells, pumping through mains to tank.

Pumping Machinery.—Dy. cap., about 250,000 galls.; Gordon steam pump at one well, windmill pump at other. *Boiler:* from Globe Steam Heater Co.

Tank.—Cap., 56,000 galls.; 15 ft. high, on 16-ft. foundation; top 131 ft. above lowest part of town.

Distribution.—*Mains*, 8 to 2-in. c. i., 2½ miles. *Services*, not given. Pipe and specials from, and laid by, R. D. Wood & Co., Philadelphia. *Taps* (Nov. 15, '89), 76. *Meters*, none. *Hydrants*, kind not given, 20. *Valves*, Eddy.

Consumption, unknown. *Pressure*, about 50 lbs., down.

Financial.—Cost, $15,000. Cap. stock, authorized, $16,000; paid up, $15,000. Debt, $500. Int., 5%. Ann. op. exp., $290.43. Ann. rev.: consumers, $964; city, $150. Hydrant rental, $7.50.

Management.—Prest., Elias K. Freed. Secy., H. S. Kriebel. Treas., A. K. Shearer. Supt., Frank S. Kriebel. Date of report, Nov. 15, '89.

OIL CITY, *Venango Co.* (Pop., 7,315; est., 12,000.) On Allegheny river and Oil creek, in center of oil district. Engaged in oil trade and manufacturing. Settled in '60; incorp. city in '71.

History.—Built in '72 by city. Des. Engr., H. P. M. Birkinbine, deceased. Const. Engr., Jno. Birkinbine.

Water Supply.—Allegheny river, pumping to reservoir, and springs, by gravity.

Pumping Machinery.—Dy. cap., over 1,500,000 galls.; two 24 x 12 x 30-in. Eclipse, 1,500,000 Gaskill dup. *Boilers*: three 60-H. P. Norse tubular.

Reservoir.—Cap., 2,500,000 galls.; in excavation and embankment, 320 ft. above pumps and 310 ft. above city.

Distribution.—(In '87.) *Mains*, c. i., 20 miles. *Services*, galv. i., lead. *Taps*, 1,000. *Meters*, 30. *Hydrants*, Mathews, 190. *Valves*, Galvin.

Consumption, not given. *Pressure*, 120 lbs.

Financial.—(In '87.) Cost, $160,000. Debt, $75,000. Int., 5 and 6%. Ann. op. exp., $4,000. Ann. rev.: consumers, $17,789.

Management.—Four Comrs. Supt., M. Dobson, South Oil City.

NOTE.—No reply received to inquiries sent in '89.

OLYPHANT, *Lackawanna Co.* (Pop., borough, 2,094; est., 5,000.) Is 4 miles from Scranton. Engaged in mining.

NOTE.—Built in '89, or under construction in '90, by Olyphant Water Co. Treas., J. T. Richards, Scranton.

ORWIGSBURGH, *Schuylkill Co.* Pop., 792; est., 1,500.)

History.—Built in '85 by town. No Engr.

Water Supply.—Source not given, by gravity.

Distribution.—(In 87.) *Mains*, c. i., 2½ miles. *Services*, galv. i., lead. *Taps*, 250. *Meters*, not given. *Hydrants*, kind not given, 17 in '85.

Consumption and *Pressure*, not given.

Financial.—(In '87.) Cost, $13,000. Bonded debt, $13,000. Int., 6%. Ann. op. exp., $400. Ann. rev.: total, $1,100.

Management.—(In '88.) Supt., Thos. J. Reed. Report made by Geo. J. Irish.

OXFORD, *Chester Co.* (Pop., 1,500; est., 1,800.) On Elk creek, on rolling ground. Settled in '40; incorp. a borough in '59. Has electric lights.

History.—Built in '69 by borough. Engr., Isaac S. Cassin, Philadelphia.

Water Supply.—Two bored wells, pumping to reservoir. Both wells are 8 ins. in diam., one being 220, other 210 ft. deep. Supply first taken from Elk creek, with drainage area of 3 sq. m. Crib dam formed impounding reservoir and furnished power to turn a 14-ft. iron over-shot water-wheel which drove two double plunger pumps, and lifted water 137½ ft. to a reservoir, 74 ft. above the main street of the town.

Pumping Machinery.—Dy. cap., 115,000 galls.; 4 and 5-in. Knowles.

Reservoir.—Cap., about 500,000 galls.; 80 ft. square at top, 26 bottom, 18 ft. deep. 74 ft. above main street of town. Banks entirely of clay, carried 6 ft. above natural surface. Inner slopes and bottom covered with 1 ft. puddled clay; bottom and slopes to within 8 ft. of top paved with brick laid flat; remaining 8 ft. of slope paved with brick on edge; whole grouted with cem. *Discharge-pipe:* 6-in. Built in '69. Cost, unknown.

Distribution.—(In '87.) *Mains*, 6-in. c. i., 3.87 miles. *Services*, lead. *Taps*, 141. *Meters*, none. *Hydrants*, Cassin, Gloucester (in '82), 35. *Valves*, Gloucester.

Consumption, est., 40,000 galls. *Pressure*, not tested, est., 30 lbs.

Financial.—(In '87.) Cost, $41,283. Debt, $37,400. Int., av., 4.9%. Ann. op. exp., $950. Ann. rev.: consumers, $1,575.

Management.—Com. of Borough Council. Secy., J. C. Kerr.

PALO ALTO, *Schuylkill Co.* (Pop., 1,583; est., 2,050.) Near Pottsville, which see.

PARKERSBURGH, *Chester Co.* (Pop., 817; est., 1,000.) Engaged in agriculture and manufacturing.

NOTE.—Jan. 22, '90, the Parkersburgh Water Co. were building works.

PARKER'S CITY, *Armstrong Co.* (Pop., est., 1,800.) On Allegheny river. Incorp. Partially sewered. No electric lights.

History.—Built in '72 by Parker's Landing and Lawrenceburgh Water Co. Des. Engr., E. Versey.

Water Supply.—Allegheny river, pumping to tanks.

Pumping Machinery.—Dy. cap., 360,000 galls.; Cameron.

Force Main.—Rise, 480 ft. No further data.

Tanks.—Cap., about 100,000 galls.; wood.

Distribution.—*Mains*, c. i., wood, 8 miles. *Services*, galv. i. *Taps*, 250. *Meters*, none. *Hydrants*, kind not given, 34.

Consumption, about 100,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 140 lbs.

Financial.—Cost (in '87), $20,000. Cap. stock, $10,000. Debt, not given. Ann. op. exp., $1,000. Ann. rev.: consumers (in '85), $2,800; city, $225 for all purposes.

Management.—Prest., O. Tinsman. Secy., R. W. Moore. Treas., D. W. Fullerton. Supt., John Walker.

PECKVILLE, *Lackawanna Co.* (Pop., not given.)

NOTE.—Both the Archbald and Olyphant Water Cos. were putting in works Jan. 22, '90. See Archbald and Olyphant.

PEN ARGYL, *Northampton Co.* (Pop., est., 2,000.) Engaged in manufacturing and slate quarrying. Incorp. borough. No sewers or electric lights.

History.—Built in '89 by Pen Argyl Water Co. Engr., J. Marshall Young, Easton. Contrs., T. M. Lesher & Son, Easton.

Water Supply.—Spring, by gravity.

Reservoir.—Cap., 1,000,000 galls.

Distribution.—*Mains*, 6 to 4-in. c. i., 3½ miles. *Services*, ¾ and ½-in. Pipe and specials from Gloucester Iron Works, Philadelphia, and Warren Foundry & Machine Co., Phillipsburgh, N. J. *Meters*, Crown. *Hydrants*, Tamaqua, 20. *Valves*, Ross.

Pressure, 100 lbs.

Financial.—Hydrant rental, $25.

Management.—W. W. Gibbs, Philadelphia. Secy., Treas. and Supt., Wm. H. Sawyer. Date of report, Mar. 1, '90.

PENN, *Westmoreland Co.* See Greensburgh.

PENNSYLVANIA REFORM SCHOOL, *Morganza, Washington Co.* (Pop., 500.)

History.—Built in '76 by State. Engr., E. Butz, Pittsburgh.

Water Supply.—Chartiers' creek, pumping to reservoirs.

Pumping Machinery.—Dy. cap., 432,000 galls.; direct-acting.

Reservoirs.—Cap., about 500,000 galls.; each 50 ft. sq. by 15 ft. deep.

Distribution.—*Mains*, c. i., 1½ miles. *Services*, lead, brass. *Taps* [probably faucets] 300. *Hydrants*, 4. *Pressure:* Ordinary, 60 lbs. Fire, 100.

Management.—Supt., A. Boland.

NOTE.—No futher data.

PETROLIA, *Butler Co.* (Pop., 1,186.) In narrow valley on Bear creek, in center of petroleum basin of Butler Co. Incorp. in '73. Has sewers. No electric lights.

History.—Built in '74 by private Co., name not given; purchased in '80 by Petrolia Water-Works, Co., Ltd. Now owned by T. Keighron. Des. Engr., F. S. Masson.

Water Supply.—Artesian well, pumping to tank for domestic use, and direct pumping for fire protection. Well is 5¾ ins. in diam., and in '83 was yielding about 200,000 galls. dy., at temperature 51° Fahr.

Pumping Machinery.—Dy. cap., 38,400 galls.; two Blake. Second was added in '76 in connection with an independent fire main of 2½-in. w. i. pipe; it has a 40-H. P. engine.

Tank.—Cap., 48,000 galls.; 175 ft. above city.

Distribution.—*Mains*, w. i., 1 mile. *Services*, galv. i., lead. *Taps*, 30. *Meters*, none. *Hydrants*, home-made, 20.

Consumption, about 1,600 galls. *Pressure:* Ordinary, 30 lbs. Fire, 150 lbs.

Financial.—Cost (in '83), $8,000. No debt. Ann. opp. exp., withheld, est., $500. Ann. rev.: consumers, $780; city, $120. Hydrant rental, $24.

Management.—Owned by T. Keighron.

PHILADELPHIA, *Philadelphia Co.* (Pop., 847,170; est., 1,000,000.) On Delaware river, 96 miles from ocean, having area of 129.2 miles. Schuylkill river flows through city, joining Delaware and forming peninsula 6 miles long, from 2 to 4 miles wide. Southern end of city is on low, alluvial land, rising gradually to north. Most of old and business part of city occupies the narrowest portion between rivers, and is from 20 to 40 ft. above sea. West of the Schuylkill, and north of old city, ground rises rapidly to height of 400 ft., and is intersected by valleys of several small streams, creating a very undulating surface.

City was founded in 1682 by William Penn, who gave it a city charter in 1701, though it was not incorp. until 1789. Original city had area of a little over 2 sq. m. This was not increased until '54, when city limits were extended to include all outlying towns in county. Considerable part of this area is still open country, many of towns near borders remaining isolated, while others have been built around until included in the main part of city. City has good water front, extensive commerce, especially coast trade, and does a large amount of manufacturing. A large proportion of the inhabitants own the houses in which they live. Has sewers and electric lights.

History.—Construction begun by city in 1800, with Benj. H. Latrobe, Engr.; water first supplied Jan. 27, '01. First works known as Centre Square. These were supplanted Sept. 7, '15, by works at Fairmount, water being pumped from Schuylkill by steam-power in both cases. Oct. 25, '22, first wheel was started at Fairmount for a water-power supply, and Jan. 14, '23, use of steam at this station was discontinued. In '26 city contracted to supply Spring Garden, Southwark and Northern Liberties; in '32 to supply Moyamensing and Kensington. Dec. 31, '44, supply to Spring Garden, Northern Liberties and Kensington was discontinued, two former places having

built joint works and Kensington taking water from them until it built works which supplied water early in '51. In '51 private Co. built works to supply Germantown, and in '55 the 24th Ward, or West Philadelphia, was supplied by works begun by it in '53. By consolidation in '54 all these works came under control of city. Chestnut Hill was supplied by a private Co. in '60. In '66 Belmont works were begun, and in '69 works were built for Roxborough, and the supply extended to Germantown, the city having controlled since '66 works built by Co in '51. In '73 city took charge of Chestnut Hill works. A system was also built, date not given, to supply Frankford, Bridesburg and vicinity.

Further historical details are given below. Also, see References.

Water Supply.—Schuylkill and Delaware rivers, and springs, pumping to reservoir and direct pumping. In '86 a population of 185,000 was supplied by direct pumping. Main supply taken from Schuylkill river at the Fairmount, Spring Garden, Belmont and Roxborough stations. Comparatively small amount is taken from Delaware river at Kensington and Frankford stations, and a very small quantity from springs at Chestnut Hill station.

Pumping Machinery.—Combined dy. cap., 194,285,000 galls., of which 44,000,000 galls. is by water-power, the rest by steam.

Spring Garden.—Total cap., 88,000,000 galls; No. 6, 8,000,000 comp. rotary; No. 7, 20,000,000 comp. rotary; No. 8, 10,000,000 Worthington dup.; No. 11, 20,000,000 horizontal Caskill; Nos. 9 and 10, each, 15,000,000 Worthington dup. These are numbered in the order put in use, Nos. 1-5 being abandoned, and 9 and 10 being at the new Spring Garden station.

Belmont.—Total cap., 18,000,000 galls.; Nos. 1 and 2, 5,000,000, and No. 3, 8,000,000 Worthington dup.

Roxborough.—Total cap., 14,750,000 galls.; No. 1, 2,250,000-gall. Cornish overhead beam; No. 2, 5,000,000, and No. 3, 7,500,000 Worthington dup.

Roxborough Auxiliary.—Total cap., as given, 785,000 galls.; No. 1, 500,000 galls., and No. 2, 285,000 galls. Knowles.

Mount Airy, auxiliary to Roxborough.—Total cap., 2,000,000 galls.; Nos. 1 and 2, each 1,000,000 Davidson.

Chestnut Hill.—Total cap., 750,000 galls.; No. 1, 250,000 Knowles; No. 2, 500,000 Worthington dup.

Frankford.—Total cap., 20,000,000 galls; No. 1, 10,000,000 Marine comp. rotary; No. 2, 10,000,000 Corliss comp. rotary.

Kensington.—Cap., 6,000,000-gall.; Worthington dup.

Fairmount—Water-Power.—Total cap., 44,000,000 galls.: all turbine wheels, No. 1, driving a 2,000,000, and Nos. 3, 4 and 5, 8,000,000 pumps, these at new house. Nos. 7, 8 and 9 each driving a 6,000,000 pump. Nos. 2 and 6 have been abandoned.

Summary of kind of pumps.—Ten Worthington, cap., 77,000,000 galls.; one Gaskill, 20,000,000; two Marine, 30,000,000; one Corliss, 10,000,000; one Simpson, 8,000,000; one Cornish, 2,250,000; two Davidson, 2,000,000; three Knowles, 1,035,000 galls.; seven turbines driving pumps with a combined dy. cap. of 44,000,000 galls.

Summary of reservoirs.—For full description, see below. Combined cap., 887,284,366 galls.: Fairmount, 26,350,794; Spring Garden, 12,009,581; Corinthian Avenue, 37,341,439; Lehigh Avenue, 26,394,180; Roxborough, 12,838,455; Mount Airy, 4,545,917; Belmont, or George's Hill, exact figures not given, but probably 39,758,000; Wentz Farm, 36,046,000; East Park, 92,000,000 galls.

GENERAL DESCRIPTION.

WATER-POWER WORKS AT FAIRMOUNT.

In '18 general plans of Frederick Graff, Sr., for water-power supply from Schuylkill at Fairmount were adopted.

Dam across river designed by Ariel Cooley, Chicopee, Mass.; Apr. 8, '19, City Council awarded him contract for its construction; price, $150,000. Work begun 11 days later, Apr. 19, and water flowed over dam July 25, '21. First wheel started July 1, '22, and put in operation for supplying water Oct. 25, '22. Jan. 14, '23, use of the Fairmount steam works was discontinued. Wheels and pumps were added to these works from time to time, the ninth, a turbine, on Dec. 16, '51.

At point where dam was built river was about 900 ft. wide. Its bottom was of rock, which for one-fourth of the distance on the east side was covered with 11 ft. of mud. Greatest high-water depth, 30 ft.; river shoals gradually to west shore.

On rock bottom dam was of log cribs, filled with stone, each crib being about 50 ft. long on axis of stream and 17 to 18 ft. wide; planked on upper side, backed with earth, and carried 13½ ft. above low-tide. On mud bottom dam was of stone spalls

and earth, 150 ft. wide at bottom, 12 at top, carried 15 ft. above other part of the dam, or 28½ ft. above low tide. Top and up-stream slope paved with stone 3 ft. thick, and a stone pier between bank and overfall protected bank, or mound dam.

Dam built obliquely across stream to give an overflow of 1,204 ft. of 13½ ft. fall at low tide. Mound dam being 270 ft. long, piers about 22 ft., and wall with arches to convey water to wheels, 104 ft., total length of dam was 1,600 ft. It backed water for 6 miles.

Timber in cribs of dam was hemlock; in '42-3 this was replaced from low tide up with white pine, and overfall extended to a length of 1,143 ft. 10 ins. Work was done with coffer dams at great risk and expense.

In '65 dam was strengthened by placing below 450 ft. of its highest part cribs filled with stone, each crib being 30 ft. wide on axis of stream, and 8 ft. long. Round hemlock timber was used from low water down, finished above with hewed white pine and decked with white oak.

In '72 a new dam was built directly in front of old one, upon rock at west end and upon the cribs sunk in '65. Overfall, 1,112 ft. long, and had two inclined aprons, with drop between them, lowest part being 2 ft. above low water. Space between old and new dams about 6 ft. wide on top, and filled with concrete.

First 9 wheels connected with these works were all breast wheels, save the last a turbine. First three were started about '22, after which one was added in '27, in '32, in '34, two in '43 and turbine in '51. Diam. of breast wheels, 15 to 18 ft., each 15 ft. wide, and they made from 11 to 14 revolutions a minute. Turbine, 7 ft. in diam., and had 10 x 13-in. buckets and made 12 revolutions a minute. Pumps were all of 16-in. bore and from 4½ to 6-ft. stroke. Nine pumps had dy. cap. of 17,309,256 galls. Wheel Nos. 1, 2 and 3 were of wood, and were replaced with iron, July, '46, after constant use for 24 years. Nos. 4, 5, 6, 7 and 8 were c. i., with wooden buckets, each weighing about 22 tons. All had c. i. shafts working under 1 ft. head and 7½-ft. fall, when dam was full and tide low. At high tide water rose 2 ft. above their lower edges, preventing use for 4 to 6 hours each day.

Total cost, in '52, of running nine wheels and pumps, $7.67 a day, or $133 for each million galls. raised to the reservoirs, or 1.3 cents for a million galls. raised 1 ft.

In '62, additional wheel-house was built to utilize surplus water during several months, and three Jonval turbines put in, each working two double-acting 18-in. pumps with strokes of 72 ins. In '69 two of old breast wheels were replaced by a turbine, two more in '70, and two in '71. In '79, 7 turbines ran 52 per cent. of time, pumping to reservoirs 20,000,000 galls. a day. Full dy. cap. of the pumps was 36,000,000 galls., but they cannot be run continuously. During 12 consecutive days in '79 only 8,000,000 galls. a day could be pumped. In the report for '87 the dy. cap. of the 7 turbines is given as 33,300,000 galls. In '72 a Worthington steam pump was placed at these works for use in the summer months. For further data see MANUAL for '88.

SPRING GARDEN WORKS.

Until '26 districts north of Vine street, including Spring Garden, Northern Liberties and Kensington, all formerly called Northern Liberties, had no general public water supply. In this year these districts made a contract with authorities of Philadelphia for a supply from their works at Fairmount, which continued in force until Dec. 31, '44. Rate was 50 per cent higher than that in the city, 6 per cent. being allowed for collection. Frontage for mains was paid by the respective property owners.

Higher rate paid for water, and considerable elevation of ground of these districts, led their authorities to obtain an act from Legislature to build works, which was granted April 18, '43, thought met by legal opposition from the city.

When the Commissioners from the three districts met to organize, those from Kensington would not co operate, so the works were begun by the other two districts, Oct. 18, '43, with Wm. E. Morris as Engr. They were put in operation Dec. 31, '44, and delivered to the joint water committee by the Commissioners, July 15, '45.

Water was taken from Schuykill through sluice to forebay, 60 x 450 ft., thence through conduits to engine house. Latter was substantial stone building with two ornamental brick chimneys, 85 and 106 ft. high, respectively.

Of first seven engines connected with these works, Nos. 1 and 2, put in at the start were alike, both being low-pressure, cond. beam engines with fly-wheels and with vertical steam cylinders. Pumps were double-acting, placed vertically under the steam cylinders, piston rods of latter being continued through bottom and connected directly to pump pistons. Pump valves were brass, hinged, working on c. i. faces. Engines had 36-in. steam, 10-in. water cylinders, both of 72-in. stroke. These two engines were in constant use for 24 years. They were built by Merrick

& Sons. In '49, engine No. 3 was built. It was a Sutton engine, double-acting cond., with vertical cylinders, connected by a bell crank to a nearly horizontal pump. Valves of bell metal, hinged. It had 33-in. steam and 21-in. water cylinders, both of 72-in. stroke; No. 4 was an overhead Cornish beam engine built in '54 by I. P. Morris & Co.: 60 x 120 x 120-ins. No. 5 was a side lever Cornish, built in '69 by Merrick & Sons; 72 x 36 x 120 ins. No. 6 was comp., high-pressure Simpson engine, built in '72 by H. G. Morris, of the Southwark Foundry, and having 36 x 61-in high, 27 x 96 in. low-pressure steam cylinders, and 28½ x 86-in. water cylinder. No. 7 was an upright, comp., low-pressure engine, of 20,000,000 dy. cap., built '75-6 by Wm. Cramp & Sons. Cylinders were placed side by side with double-acting plunger pump beneath each. Steam cylinders are 45 and 80 ins. in diam., the pump 30 ins., all of 72-in. stroke. First three engines were used up, as early as '79, and at that time the remaining four pumped a dy. av. of 12,250,000 galls. No. 5 has been removed and No. 6 is now used only occasionally. A 10,000,000 Worthington dup., and a 20,000,000 Holly-Gaskill pump have since been added at old station, and a new station established with two 15,000,000 Worthington dup. Combined dy. cap. of pumps at this station is 88,000,000 galls.

First boilers were three tubular and one plain cylinder, with two mud drums for each, built by I. P. Morris & Co. Later two hog-nose tubular boilers were built for the works by Matthews & Moore.

In '69 Neafie & Levy built 6 plain cylinder boilers with two mud drums for each. In '71 the four original boilers were replaced by five plain tubular ones, built by I. P. Morris & Co.

In '54 number of pumps and the smallness of the mains made necessary the erection of a stand-pipe, with which all the pumps were connected. It was 137 ft. high, and tapered from a diam. of 6 ft. at the bottom to 3½ at the top.

Reservoirs connected with this and other works still in operation will be described together farther on. As has been stated, these works have been controlled by city since '54.

DELAWARE OR KENSINGTON WORKS.

The Kensington district, lying north of old city on Delaware side, built independent works in '51. It had been supplied from '26 to '44 by Fairmount works, and from '44 to '51 by Schuylkill works. Water was pumped from Delaware river, through 18-in. main, to two reservoirs 112 ft. above mean tide.

No. 1 is a double acting high-pressure engine, with 30x72-in. cylinder, connected by an 18-ft. vertical lever beam to a double-acting horizontal pump, 18x72 ins. No. 2 is a condensing engine with a 42x62-in. vertical cylinder. Piston rod connected above with a beam operating a fly-wheel, and below with a bell crank working a horizontal pump, 19½x72 ins. In '71 a 6,000,000 Worthington dup. was added, and the other pumps have since been abandoned. In same year a new reservoir was finished, and a new 36-in. main laid to it from a stand-pipe, a distance of 11,858 ft.

In '49 there were built for these works by I. P Morris & Co. six plain cylinder boilers, each having one mud drum. In '65 two similar boilers, built by Matthews & Moore, and in '72 five more, built in the Southwark Foundry, were added. Previous to this a marine boiler, built by Reanie & Neafie, had been set, but in '72 this was transferred to Fairmount works, to run Worthington pump.

OLD GERMANTOWN AND OLD TWENTY-FOURTH WARD WORKS.

Both plants have been abandoned. See MANUAL for '88.

CHESTNUT HILL WORKS.

Extreme northwest corner of city, east of Schuylkill, was supplied in '60 from works built by a private company, taking water from a well and spring by two horizontal engines, driving a double-acting 7x48-in. pump, and raising water 125 ft. to a 40,000-gall. tank.

These works were bought by the city in '73 for $65,000, at which time they supplied from 76,740 to 153,480 galls. a day. In '76 a 250,000-gall. Knowles pump was added. In '79 the daily supply was 239,815 galls., which was insufficient. Since then a 500,000-gall. Worthington dup. pump has been added, and dy. cap. of station is now 750,000 galls.

ROXBOROUGH AND GERMANTOWN SUPPLY.

For the supply of these two places, in the northwestern district, and south of Chestnut hill, works were begun in '66. Water was raised from Schuylkill river by a 2,250,000-gall. Cornish over-head beam engine built by Matthews & Moore. Both were started in '69.

Pump had 72-in. steam and 20-in. water cylinders, all of 120-in. stroke, and lifted water to a reservoir against a head of 334 ft. In '72 a 5,000,000, and later a 7,500,000, Worthington pump was added.

In '75 a stand-pipe was finished, which, with two Knowles pumps, furnished water to Germantown. Stand-pipe was made of ordinary 30-in. mains.

Dy. cap. of present main station is 14,750,000 gall.; of the Roxborough auxiliary, 785,000 galls.; of the Mount Airy auxiliary 2,000,000 galls., there being two Davidson pumps here.

BELMONT WORKS.

Begun in '66 and put in operation in '70; located at Belmont, on Schuylkill, a short distance above the 24th Ward, or West Philadelphia, works, which these supplemented. Engine No. 1 was started in '70, No. 2 in '71, and No. 3 later; all Worthington; the first two 5,000,000-gall., last, 8,000,000-gall.; and pumped to reservoir against 212 ft. head. These works are for the exclusive supply of West Philadelphia. Dy. cap., 18,000,000 galls.

FRANKFORD WORKS.

Supply Frankford, Bridesburg and their vicinity, by pumping from the Delaware river at Lardner's Point A 10,000,000 Cramp and a 2,500,000 Worthington engine were first placed at this station, but there are now at this station two comp., rotary engines, one a marine and the other a Corliss, each having dy. cap. of 10,000,000 galls.

RESERVOIRS.

Fairmount.—Cap., 26,350,794 galls.; filled from Fairmount pumping station, and supplies that part of the city, from river to river, lying below South street. In four basins, fourth having three sections; 94.14 ft. above city datum, 51 ft. above highest, 91 above lowest, curb in old city proper. In earthwork, lined with brick, is 12¼ ft. deep. First basin, finished in '15, is 167 x 317 ft.; second, finished in '21, 140 x 316 ft.; third, finished in '27, is 160 x 317 ft.; first section of fourth, finished in '35, is 136 x 350 ft.; second section of fourth, finished in '35, third, in '36, third and fourth together being 358 x 392 ft. First basin cost $32,509; second, $9,579; third, $24,522; fourth, $67,214. Total cost, $133,824.

Distributing Mains from Fairmount Reservoirs.—First, 22 ins. in diam. for 2,561 ft., then reduced to 20 ins., and partly of pipe imported from England; begun in '19, and was 12,177 ft. long. Second, laid in '29, was 11,823 ft. long, 20 ins. in diam. for the first 10,956 ft., then 16 ins. Third, laid in '50, 13,821 ft. long and 30 ins. in diam.

Spring Garden Reservoir.—Cap., 12,009,581 galls.; built in '44; supplied from Spring Garden and Fairmount works. Has puddled earth embankments, lined with brick. When first filled bank broke, but it was successfully repaired. Water level, 115 ft. above river; depth, 17 ft.

Corinthian Avenue Reservoir.—Cap., 37,341,439 galls.; finished in '52; is supplied from Fairmount and Spring Garden works. Until '60 it never held over 11 ft. of water without leaking, but it has since been repaired so it holds about 25 ft. When full water level is 120 ft. above city datum, 66.94 ft. above highest and 98.14 ft. above lowest curb in city, and 16 ft. higher than Fairmount reservoir. To fill it a stand-pipe was built at Fairmount, of 48-in. c. i. pipe, 50 ft. high from its base, 30 ft. above level of Fairmount, and 14 ft. above level of Corinthian avenue reservoir. To this stand-pipe force main of Fairmount works is attached so as to throw its supply into the Corinthian avenue reservoir when desired. From base of stand-pipe 30-in. main is carried 3,747 ft. to Corinthian Ave. basin. Cost, to '52, when water was admitted, exclusive of land damages, was $16,030.

Supply reaches Corinthian Ave. reservoir from Spring Garden works through a 30-in. main, and, when Fairmount reservoir is full and the river up, from Fairmount works *via* stand-pipe through 48-in. and 30-in. main. It has four 30-in. outlets; one to Kensington basin; one to First district, south of South street; one to Spring Garden district, and one blank. In '66 introduction of a supply through a 48-in. pipe over bank, and dropping 9 ft. on the lining-wall, caused a slide of wall and some other damage.

Lehigh Avenue Reservoir.—Cap., 26,394,180 galls.

Corinthian Avenue, Spring Garden and Lehigh Avenue Reservoirs supply city north of South St. to Westmoreland, except a part supplied by direct pumping. The storage cap. of the three reservoirs is 75,745,200 galls.

Roxborough Reservoir.—Cap., 12,838,455. Supplies Manayunk, or 21st Ward. Finished in '68. Is 375 ft. above tide, 365 ft. above city datum, 410 x 240 ft., x 12 ft. deep. Embankments, disintegrated mica schist, with clay lining. When first filled

for 6 ft. it leaked, and after being repaired and filled a few feet more it again leaked, necessitating further repairs. New 30-in. main laid to Mt. Airy reservoir in '89.

Mount Airy Reservoir.—Cap., 4,545,917 galls. Supplies, 22nd and part of 28th Wards. Is 362 ft. above city datum, and is filled from Roxborough station, there being auxiliary pumps here. Built in connection with old Germantown works.

Belmont or George's Hill Reservoir.—Cap., 39,758,000 galls. Supplies West Philadelphia. Filled from Belmont station; begun in '66, finished in '70.

Wentz Farm Reserveoir.—Cap., 36,046,000 galls. Supplies Frankford and Bridesburg. Filled from Frankford station, on Delaware river, and was finished in '77. In embankment, formed of micaceous sand, with slopes of 2 to 1, lined with clay puddle. Built to hold 24 ft. of water, or 36,046,097 galls., which would give 15 days storage, but owing to defective construction it can be filled but 11 ft.

East Park Reservoir.—Cap., 692,000,000 galls.; in three basins, of 60,000,000 galls., 310,000,000 galls.; and 322,000,000 galls. Begun in '71 and nearly ready for lining in '77, but work on it was abandoned for several years, first section being finished in '87, second in '88, third in '89. It will be filled from Spring Garden or Belmont station, and will be a great value as a settling basin, aside from storage.

The work done on the reservoir in '87 consisted almost wholly of lining it, and the contract was given to Lewis Grant, Pottsville, for $1.29 sq. yd. Bottom lining is a 5-in. layer of concrete, composed of 4 parts of broken stone, 2 of sharp sand and 1 of best Portland cement. The concrete was joined to form one continuous sheet over bottom, and the upper surface covered with a composition of 2 parts of sand and 1 of cement. Sides are paved with hard brick, laid flat in 2 ins. of cement mortar, composed of 2 parts of sand and 1 of cement.

In '89 a 48-in. supply main was laid from this reservoir to district formerly supplied from pumps at Otis street wharf, Delaware river.

RIVER CROSSINGS.

In '70 a pipe aqueduct was laid over Wissahickon creek after designs by F. Graff. Two lines of 20-in. c. i. pipe with flange joints formed top chord of a 165-ft. span which was trussed by w. i. links, and rested on Phœnix columns, the pipe being 100 ft. above creek. In Feb., '75, one of pipes was destroyed by frost, and in '76 a siphon was substituted for bridge, pipe being laid in an oak cradle, then submerged. Pipe at lowest point is under 205 ft. head. It is 20 ins. in diam. and 11-16 ins. thick.

In '68 Mr. Graff laid a 36-in. pumping main across the forebay at Fairmount in a similar way.

In '70 a submerged pipe, 963 ft. long, was laid across Schuylkill in 26 ft. of water. It had Ward's flexible joint.

Distribution.—*Mains*, c. i., 901 miles. *Services*, w. i., lead. *Taps*, 172,604. *Meters*, 267. *Hydrants*, department design, 6,929. *Close of* '60: Mains, 325 miles. Hydrants, 2,845. *Close of* '70: Mains, 488 miles. Hydrants, 3,118. *Close of* '80: Mains, 746 miles. Hydrants, 5,883.

Consumption, 101,780,744 galls. *Pressure*, 18 to 150 lbs.

Financial.—Cost, approximately, $15,000,000. Debt (in '87), $6,401,800. Int., not given. Ann. op. exp., $652,441. Ann. rev.: total, $2,114,927. Ann. rev., '60, $558,532. Do., '70, $935,371. Do., '80, $1,446,342.

Management.—Bureau of Water. Chief Engr., Jno. L. Ogden. Asst. Engrs., Allen J. Fuller, Wm. Whitby. Genl. Supt., Frank L. Hand.

References.—See MANUAL for '88, both for list of references and for much matter not given above, especially under Historical Description.

Tenth Census. U. S., vol. XVII., Water Supply of Cities, pp. 125-144.

PHILLIPSBURGH, *Centre Co.* (Pop., 1,779: est., 3,000.) Engaged in lumbering and coal mining, and manufacturing. Incorp. Has sewers, electric lights and steam heating.

History.—Built in '81 by Phillipsburgh Water Co.

Water Supply.—Cold stream, pumping to reservoir.

Impounding and Water-Power Dam and Reservoir.—Cap., not given; area, 20 acres. Dam of clay, 800 ft. long, 6 to 12 ft. high, 5 to 10 ft. of water; 12 ft. wide on top, 30 to 50 ft. at bottom. Inner slope cribbed with logs, outer, has dry stone wall. *Spillway:* 40 ft. wide, 5 ft. deep, 100 ft. from end of dam, in earth, timbered and planked. *Flood-gates*: 12 ft. wide, extending to bottom of dam. Dam does not leak badly. Built many years ago, improved from time to time.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; 500,000 W. P. Duncan & Co.'s plunger; 1,500,000 Gaskill comp., dup.

Distributing Reservoir.--Cap., 300,000 galls.; mostly in rock excavation, 50 x 75 ft. at top, 40 x 65 ft. at bottom, 16 ft. deep. Built by Co. Cost, $2,000.

Distribution.—*Mains*, c. i., 6½ miles. *Services*, galv. i. *Taps*, 450. *Meters*, . *Hydrants*, W. P. Duncan & Co.'s, 48.

Consumption, 400,000 galls. *Pressure*, 55 lbs.

Financial.—Cost, $40,000. Cap. stock, $40,000. No debt. Ann. op. exp. (in '87), $2,400. Ann. rev.: consumers, $6,675; city, $720. Hydrant rental, $15.

Management.--Prest., J. N. Casanova. Secy., Wm. E. Irwin. Treas., O. P. Jones. Supt., Henry Southard.

PHŒNIXVILLE, *Chester Co.* (Pop., 6,682; est., 7,500.) On west bank of Schuylkill river, at mouth of French creek, which flows through middle of town; 27 miles from Philadelphia. Manufactures iron, iron bridge material and machinery.

History.—Built in '72-3 by borough. Engr., Isaac S. Cassin, Philadelphia. In '80 the Phœnix Iron Co. built works for supplying their shops.

Water Supply.—Schuylkill river, pumping to reservoir.

Pumping Machinery.—Dy. cap., 3,500,000 galls.; Worthington.

Force Main.—Rises 195 ft. No further data.

Reservoir.—Cap., 2,520,596 galls.; in excavation and embankment, lined with brick in cem. on 18 ins. of clay puddle. Contrs., Rehill & McTague, Pottstown.

Distribution.—*Mains*, c. i., 4 to 16-in., 15 miles. *Services*, lead. Pipe and specials from Mellert Foundry & Machine Co., Reading, and Warren Foundry & Machine Co., Phillipsburgh, N. J. Pipe laid by W. T. Wilkinson, Phœnixville. *Taps* (in '85), 802. *Meters*, 4. *Hydrants*, Mathews (in '85), 126. *Valves*, Ludlow.

Consumption (in '87), 500,000 galls *Pressure*, 65 to 75 lbs.

Financial.—(In '87.) Cost, based on bonds issued, $397,000. Bonded debt, $192,200. Int., 4.7%. Ann. op. exp. (in '88), 16,418. Ann. rev.: total, $15,872.

Management.—Com. of three. Supt., A. S. Vanderslice.

PITTSBURGH, *Allegheny Co.* (Pop., 156,389; est., 215,000.) At junction of Allegheny and Monongahela rivers, forming the Ohio. Along river banks a narrow strip of land with area of 5.16 sq. m. rises 120 ft. above river and comprises business part of city. Of remainder of city 8.61 sq. m. rises 120 to 250 ft., 7.06 sq. m. rises 250 to 400 ft., and two summits rise 520 ft. above river. A steep hillside on south side of Monongahela river is also within city limits. In iron and coal region, having extensive manufactories, especially iron Ohio river is navigable to this point, giving river commerce. Occupied as an English military post in 1754, settled as a village in 1758, and incorp. a city in '16. Has sewers and electric lights.

History.—Built in '26 by city; new works built in '42-4, and in '72-8. Engrs. of works built in '44, R. Moore; of works built in '78, E. S. Chesbrough and Moses Lane. Jas. H. Harlow, Pittsburgh, Asst. Engr., '72-4.

Population in '26 was about 12,000, and Feb. 24 an ordinance was introduced in councils, providing for loan to construct water-works. This was ratified by a nearly unanimous vote of citizens. Water committee was appointed from councils to supervise work, and money was loaned city by Pittsburgh and Exchange banks. Site for engine house cost $1,425, and for reservoir, $3,800. Former located at corner of Duquesne Way and Cecil Alley; latter at what was afterwards site of court-house burnt about '82, and was a lot 240 ft. sq. In '29 revenue from works was $3,086. For first three years consumption was but 4,000 galls. a day.

Second works were put in operation July 4, '44, at which time consumption did not exceed 1,000,000 galls. a day, although 9,000,000 galls. pumping cap. was provided.

Water Supply.—Allegheny river, pumping to reservoirs. New supply in '78 was taken at Negley's, about 10 miles above lowest point of city.

Pumping Machinery.—Dy. cap., 50,000,000 galls.; 20,000,000 (at least) Lowry, 7,500,000 Worthington, remainder not given.

Pump erected in '26 had dy. cap. of 1,500,000 galls. In '44, 9,000,000-gall. pumps were added; engines called "Sampson" and "Hercules" both high-pressure, worked on incline, had wooden connecting rods, and were used till completion of new works, in '78, or later. These two lifted water to Bedford Ave. reservoir, 135 ft. above river. In '45 two horizontal, non-cond., 15 x 11 x 72-in. pumping engines were erected at reservoir to lift water to "old high service" basin. In '69 Lowry pumping engine was added at reservoir, with 26 x 9 -in. steam cylinders, driving two 18¾ x 72-in. pumps.

In '70, direct-pumping works were built at 45th St., with three pumps [probably 2,500,000-gall. Worthington, as 7,500,000 Worthington have been reported]. This station has been abandoned, but one pump, rated at 1,500,000 galls., was used in '80 to force water to Heron hill high service reservoir.

At works built in '78, 4 horizontal high-pressure Lowry engines drive two pumps with cap. of 10,000,000 galls. each, at 10 strokes per minute; engines made comp. cond., by adding low-pressure, at end of high-pressure cylinders. Low-pressure cylinders, 106, high-, 64, pump, 44 ins. in diam.; all 14-ft. stroke. Pumps work vertically, being joined to horizontal piston rod by triangular beam.

Force-Main.—C. i., 50-in , 3,840 ft. long; rise, 365 ft.

Hiland Reservoir.—Cap., 118,000,000 galls.; in two compartments, of 81,000,000 and 37,000,000 galls.; area, 19¾ acres; depth, 20 ft.; 365 ft. above river. Banks of earth, free from stone, rammed in 6-in. layers; no heart-wall; 24 ft. high, 20 ft. wide on top, 118 at bottom. Inner slopes 1½ to 1, covered with 2 ft. of puddle, 9 ins. broken stone, then 15-in. stone paving in hydraulic cement, stone not more than 12 ins. wide on face of slope; slope surmounted by 6-in. coping, 2 ft. wide; foots on course of stone, surrounded on sides and bottom by 5 ins. of concrete Bottom covered with 5 ins. of concrete on 1 ft. of puddle, connected with puddle of slope. Outer slope, 1¾ to 1. *Discharge-pipes:* two 12-in., for cleaning. Reservoir has small leakage. Built in '76. Des. Engrs., see History. Const. Engr., W. H. Kennedy. Contrs., Howard & Son, Pittsburgh.

Distribution.—*Mains*, c. i., 190 miles. *Services*, lead. *Taps*, about 17,681. *Meters*, 15. *Hydrants*, Ludlow, 1,612. *Valves*, Ludlow.

Consumption, 34,000,000 galls. *Pressure*, 70 lbs.

Financial.—Cost, $4,752,000, or over. Debt, $4,752,000: $4,452,000 at 7, $300,000 at 6%. Sinking fund, $1,357,212. Ann. op. exp., about $100,000. Ann. rev.: consumers (in '89), $547,008.

Management.—Supt., Geo. H. Brown.

References.—*Eng. News*, vol. VI., p. 62, relating to pumping engines; vol. VI., p. 271, Hiland reservoir; vol. VI., p. 359, break of air-chamber of pumps; vol. XII., p. 250, early history; vol. XIX., p. 547, wells.

Tenth Census U. S., vol. XVII., Water Supply of Cities, pp. 90-4.

PITTSTON, *Luzerne Co.* (Pop., 7,472; est., 12,000.) On Susquehanna river at head of Wyoming Valley, 3 miles from Wilkes-Barre and 9 from Scranton. On broken and hilly ground, business part of town lying along river. Has extensive coal mines and a number of manufactories. Settled in 1776; incorp. borough in '53. Has sewers and electric lights.

History.—Built in '55-7 by Pittston Water Co., who also supply W. Pittston. Contrs. for W. Pittston extension, Ferris & Halladay, Jersey City, N. J.

Water Supply.—Susquehanna river, pumping to reservoirs.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; 2,000,000 Worthington comp., dup., erected in '77, 1,000,000 Knowles double-acting plunger, erected in '82. First pump was a rotary, but did not work well.

Reservoirs.—Cap., 2,500,000 galls.; two, in excavation and embankment, one holding 2,000,000 galls. at 166 ft. above pumps; one holding 500,000 galls., at 191 ft. above pumps.

Distribution.—(In '87.) *Mains*, c. i., 21 miles. *Services*, galv. i. *Taps*, est., 1,900. *Hydrants*, Mathews, principally, 28. *Valves*, Eddy, mostly.

Consumption and *Pressure*, not given.

Financial.—(In '87.) Cost, $114,000. Cap. stock, $76,400. Debt, $69,000 at 4%. Ann. op. exp., $8,000. Ann. rev.: consumers, about $28,000; city, $350. Hydrant rental, $12.50.

Management.—(In '88.) Prest., Alex. Craig. Secy., A. A. Bryden. Treas., A. L. Bryden.

NOTE.—No report received for '88.

PLEASANT VALLEY, (*Avoca P. O.*) *Bucks Co.* See Moosic.

PLYMOUTH, *Luzerne Co.* (Pop., 6,035; est., 10,000.) On Susquehanna river, at lower end of Wyoming valley, at foot of Shawnee or Plymouth mountain. In coal region. Incorp. No sewers. Has electric lights.

History.—Built in '75-6 by Plymouth Water Co. Engr., Jas. H. Brown. Contr., A. H. Coon, Kingston, Pa.

Water Supply.—Surface water and springs, by gravity from impounding reservoirs; artesian well and Susquehanna river, pumping to reservoir; latter in dry

seasons. Impounding reservoirs are on stream having drainage area of 2½ sq. m. Well is 1,959 ft. deep and in '86 yielded 15,000 to 20,000 galls., or by pumping, 150,000 galls. a day.

Dams and Reservoirs.—Cap., 9,360,000 galls. *No.* 1: cap., 300,000 galls.; 265 ft. above borough; acts as a receiving and distributing reservoir for all sources of supply. Dam of cut stone. Nos. 2, 3 and 4 have cap. of 1,500,000, 2,500,000 and 5,000,000 galls., respectively. Dam of No. 2, cut stone, and those for Nos. 3 and 4, stone, backed with earth.

Pumping Machinery.—Dy. cap., 800,000 galls.; two Griscom, each of 12-in. steam cylinders, with two 6½-in. plungers, all of 36-in. stroke. There has been a Knowles pump at well, but no mention of it is made in report for '88. It was 14 x 8½ x 48 ins.

Distribution.—*Mains*, c. i., 16 miles. *Services*, galv. w. i. *Taps*, 1,000. *Meters*, 4. *Hydrants*, Bailey, 40. *Valves*, Eddy. *Close of* '80: Mains, 12 miles. Taps, 600. Meters and Hydrants, none.

Consumption, 650,000 galls. *Pressure*, 120 lbs.

Financial.—Cost, $100,000. Cap. stock, $100,000. No debt. Ann op. exp., $4,500. Ann. rev.: consumers, $14,200; city, $900. Hydrant rental, $22.50. Cost, close of '80, $50,000. Rev., '80, $8,600,

Management.—Prest., Draper Smith. Secy. and Treas., J. W. Chamberlain. Supt., O M. Lance.

PORT CARBON, *Schuylkill Co.* (Pop., 2,346; est., 3,000.) Near, and supplied from, Pottsville, which see.

PORT PERRY, *Allegheny Co.* See Wall.

POTTSTOWN, *Montgomery Co.* (Pop., 5,305; est., 12,000.) On Schuylkill river. Engaged in manufacturing nails, boiler-plate and ship-iron, iron bridges boilers, steel ingots, machinery, agricultural implements and cigars. Settled in 1730; incorp. city in '12.

History.—Built in '69-71 by Pottstown Gas & Water Co. Engr., Isaac S. Cassin Philadelphia. Work done by day.

Water Supply.—Schuylkill river, pumping to reservoir.

Pumping Machinery.—Dy. cap., 2,500,000 galls.; 1,000,000 Worthington, 1,500,000 pump made by Philadelphia Hydraulic Works. *Boilers:* two return tubular, each 5 x 22 ft.

Reservoir.—Cap., 1,500,000 galls., at depth of 17 ft.; 140 ft. above river, 100 ft. above town.

Distribution.—(In '87.) *Mains*, c. i., 15 miles. *Services*, lead, w. i. Pipe and specials from Mellert & Kinley, Reading; pipe laid by Jno. Worthington, Philadelphia. *Taps*, about 1,200. *Meters*, 6. *Hydrants*, Mellert & Kinley, Reading, about 120. *Valves*, kind, do.

Consumption (in '87), 450,000 galls. *Pressure*, 60 lbs.

Financial.—(In '87.) Cost, $125,000. Cap. stock, $90,000. Bonded debt, $10,000. Int., 4½%. Ann. op. exp., withheld, est., $2,500. Ann. rev.: withheld, est., $18,000. Hydrant rental, none.

Management.—(In '88.) Prest., Isaac Fegely. Secy. and Treas., J. H. Maxwell. Supt., Hiram Royer.

NOTE.—No report in answer to inquiries sent in '89.

POTTSVILLE, *Schuylkill Co.* (Pop., 13,253; est., 15,000. Est. pop. supplied, 25,000.) On Schuylkill river, on hilly ground rising 200 ft. from river. Engaged in mining and shipping coal. Settled in 1800; incorp. borough in '31. Has sewers and electric lights.

History.—Built in '34-6 and extended in '54 and '75 by Pottsville Water Co. Extended to supply St. Clair in '54, Palo Alto in '55, Port Carbon in '79.

Water Supply.—Mountain streams, by gravity from impounding to distributing reservoirs. First supply, from spring. In '54 water was brought by gravity from Wolfe creek to distributing reservoir in town. In '75 storage reservoir was built on Eisenhuth run.

Reservoirs.—Combined cap., 450,000,000 galls *Distributing:* cap., 5,000,000 galls. *Eisenhuth:* cap., 300,000,000 galls.; area, 70 acres; 800 ft. above town; dam, earth, 1,350 ft. long, 35 ft. high, 40 ft. wide on top; slopes of 2 and 2½ to 1. *Kauffman:* cap. 150,000,000 galls.; dam of earth, 600 ft. long, 61 ft. high. Built in '86.

Conduit and Supply Main.—A 12-in. conduit, 4 miles long, to distributing reservoir. A 12-in. c. i. main from Eisenhuth reservoir to town.

Distribution.—*Mains*, c. i. (in '87), 36 miles. *Services*, lead. *Taps*, withheld, est., 2,200. *Meters*, 12. *Hydrants*, kind and number withheld, est..

Consumption, not given. *Pressure*, 120 to 0 lbs.

Financial.—Cost, withheld, est., $275,000. Cap. stock, $200,000. Bonded debt, $69,000. Int., not given. Ann. op. exp., withheld, est., $3,500. Ann. rev.: consumers, withheld, est., $38,000; city, none in '83.

Management.—Prest., D. W. Bland. Secy. and Engr., Wm. D. Pollard.

PUNXSUTAWNEY, *Jefferson Co.* (Pop., 674; est., 1,500.) On Mahoning creek, in mining, grazing and agricultural and lumber district. Not incorp. No sewers or electric lights.

History.—Built in '87 by Punxsutawney Water Co. Work done by day labor.

Water Supply.—Mahoning creek, pumping to tank.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; 250,000 Epping direct-acting, 750,000 Gordon dup.; latter added in '89. *Boilers:* old from Monroe & Co., Pittsburgh; 40-H. P. tubular, added in '89, from Erie City Iron Works.

Tanks.—Combined cap., 78,000 galls.; two tanks from Alex. Watson, Bradford.

Distribution.—*Mains*, 6 and 4-in. c. i., 4 miles. *Services*, lead. Pipe furnished by R. D. Wood & Co., Philadelphia. *Taps*, 135. *Meters*, 2. *Hydrants*, Mathews, 20. *Valves*, and other material, Epping, Carpenter & Co., Pittsburgh; Mueller Mfg. Co., Decatur, Ill.

Consumption, 175,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 80 lbs.

Financial.—Cost, $16,000. Cap. stock, $15,000. Debt, floating, $2,400. Int., 6%. Ann. op. exp., $1,000. Ann. rev.: consumers, $1,200; railroad, $175; city, $200. Hydrant rental, $16.25.

Management.—Prest., R. C. Winslow. Secy., H. G. Miller. Treas., L. Pantall, Supt., Chas. E. Ratz.

READING, *Berks Co.* (Pop., 43,278; est., 60,000.) On Schuylkill river. Has various manufactories. Incorp. Sewers built in '89-'90. Has electric lights.

History.—Built in '19-21 by Reading Water Co., and purchased in '65 by city.

Co. incorp. by Act of Assembly, Mar. 16, '19, the Commissioners named being Jno. Spayd, Frederick Heller, Jno. Adams, Geo. de B. Keim and Jno. Birkinbine. Co. bought Hampden spring and land surrounding it, which was then northeast of Reading, but is now within city limits. Reservoir was built at head of Penn street and water conveyed to it from spring through 1.05 miles of 2½-in. pipes, some earthen, and some wooden logs. July 19, '21, water was let into reservoir and following October distributed through town. Reservoir had cap. of "one thousand hogsheads," or about 600,000 galls., and spring had a dy. flow of 100,000 galls. Distributing pipes were principally of iron 2 to 4 ins. in diam. In '33 over $20,000 had been expended, 250 families were supplied, annual income was $1,500, population of town was about 6,500. No record of Des. Engr., but Mark B. Scull was Supt. of Co. for last 20 years of its existence. April 1, '65, Co. sold its works and franchises to city for $300,000.

Water Supply.—Hampden, Mineral and Edelman springs, Bernhart and Antietam creeks, by gravity. Creeks flow through sandstone formation, and there is an impounding reservoir on each, and three distributing reservoirs. Drainage area and min. dy. flow of each of the sources of supply is: Hampden spring, ¼ sq. m., 80,000 galls.; Mineral spring, ½ sq. m., 120,000 galls.; Edelman spring, ¼ sq. m., 50,000 galls.; Bernhart creek, 2½ sq. m., 600,000 galls.; Antietam creek, 4½ sq. m., 950,000 galls. Total, 8 sq. m., 1,800,000 galls. In '89 $150,000 was appropriated for and work begun on additional supply, including new reservoir and a pump.

Pumping Machinery.—Dy. cap., 5,000,000 galls.; Worthington comp., cond.; built in '89.

Dams and Reservors.—Cap., 154,250,000 galls.; or 38½ days' storage for av. dy. consumption of 4,000,000 galls.

City Reservoirs.—Cap., 6,250,000 galls.; northern basin, 2,750,000; southern, 3,500,000 galls. Built by Reading Water Co., the first in '21, second in '48, and enlarged in '72 by city at expense of $16,869. Engr. for latter work, E. F. Smith. Contr., Owen O'Reilly.

Bernhart Reservoir.—Cap. 41,000,000 galls. Original reservoir was formed by dam built in '58 by Reading Water Co. This was abandoned in '69 upon completion of a new reservoir, formed by a much larger dam, built by the city in '69, and having a cap. of 20,000,000 galls. In '86 reservoir was enlarged to present cap. Engr. for work in '69 and '86, E. F. Smith. Contr. for work in '69, Owen O'Reilly; in '86, E. J. Nolan. Cost of work done in '69, about $18,500; in '86, $17,225. Total cost of present Bernhart dam and reservoir, about $36,000.

Antietam Reservoir or Lake.—Cap., 80,000,000 galls. Built in '80-1, with H. P. M. Birkinbine, deceased, as Engr., and Christian Eben, Contr. Cost of dam and reservoir, $49,595; of damages to mills and riparian owners, $107,888. Total, $157,483. Dam 3¼ miles northeast of city.

Hampden Reservoir.—Cap., 27,000,000 galls. Built in '82-3 with City Engr. A. Harvey Tyson, in charge; Nolan Bros. were Contrs. for reservoir, and Hoskin & Guiles for sodding same. Total cost $136,557, of which $13,106 was paid for sodding.

Conduit.—From Antietam lake to city reservoirs; 16 and 20-in., about 3 miles long.

Tunnel: on conduit, 1,700 ft. long. No further data.

Distribution.—*Mains*, 4 to 20-in. c. i., 100 miles. *Services*, w. i., lead. *Taps*, (in '87), 21,940. *Meters*, 30. *Hydrants*, Adams, Tamaqua, 425. *Valves*, Douglas & Connard, Reading.

Consumption, 3,500,000 galls. *Pressure*, 35 to 65 lbs.

Financial.—Cost, $1,100,000. Bonded debt, $418,010: $205,000 at 6, $130,010 at 5, $83,000 at 4%. Sinking fund, $52,490. Ann. op. exp., $82,014. Ann. rev.: total, $108,795; city, none.

Management.—Four Comrs. Secy. and City Clerk, Cyrus T. Fox. Supt., Wm. B. Harper.

RENOVO, *Clinton Co.* (Pop., 3,708; est., 4,500.) On West branch of Susquehanna river, in mountainous mining and lumber region; has railroad machine shops. Settled in '63; incorp. city in '67. No sewers. Has electric lights.

History.—Built in '72-3 by city. Des. Engr., —Welsh. Const. Engr., Pharon Jarrett, deceased. Contrs., Scheid & Jarrett, Lock Haven.

Water Supply.—Peters' run, by gravity, with pumping when water is low.

Pumping Machinery.—No data.

Dam and Reservoir.—Cap., 2,000,000 galls.; area, about one acre. Dam not described: on stream, ¾ mile from and 150 ft. above city. There has been a tank in connection with works, but it is not stated whether this is now in use.

Distribution.—*Mains*, w. i. and cem., 5 miles. *Services*, w. i. *Taps*, 475. *Meters*, none. *Hydrants*, kind not given, 62.

Consumption, not given. *Pressure*, 150-ft. head.

Financial.—Cost, $57,000. Debt, $46,359. Int., 4 and 4½%. Ann. op. exp., $125. Ann. rev.: consumers, $2,850.

Management.—Supt., Ed. Mullen.

REYNOLDSVILLE, *Jefferson Co.* (Pop., 1,410; est., 2,500.) In bituminous coal region; engaged in mining, lumbering, milling, and coke-making. Incorp. No sewers. Has electric lights.

History.—Built in '88 by Reynoldsville Water Co. Contr., R. B. Thomas, Clarion. Supplies Horatio.

Water Supply.—Springs, pumping to tanks.

Pumping Machinery.—Dy. cap., about 350,000 galls. Made by Jno. Jenks, Brookville.

Tanks.—Two; cap., about 36,000 galls. each.

Distribution.—*Mains*, 8 to 4-in. c. i., 3½ miles; from R. D. Wood & Co., Philadelphia. *Taps*, 40. *Meters*, none. *Hydrants*, Mathews, 18. *Valves*, Chapman.

Consumption, 1,600 galls. *Pressure*, about 100 lbs.

Financial.—Cost, $11,000. No debt. Hydrant rental, $25. Other data withheld or not determined.

Management.—Prest., F. Arnold. Secy., M. M. Davis. Treas., Himan Cooper. Supt., M. S. Sterley.

REYNOLDTON, (*McKeesport P. O.*) *Allegheny Co.* (Pop., est., 2,000.) Near McKeesport. Incorp. borough. No sewers or electric lights.

History.—Built in '89 by borough: put in operation about Jan. 1, '99. Engr., Jas. Escolf, McKeesport.

Water Supply.—McKeesport water-works, through 8-in. main beneath Youghiogheny river. It is hoped that after 5 years borough can build a pumping station.

Distribution.—*Mains*, c. i., ¾ mile. *Services*, lead. Pipe and specials from R. D. Wood & Co., Philadelphia; laid by borough. *Meters*, 1. *Hydrants*, Mathews, 21. *Valves*, Eddy.

Pressure, 110 lbs.

Financial.—Cost, $10,000. Debt, $10,000. Int., 6%.

Management.—Secy., Wm. Kemumier, Hero. Supt., Malcolm Johnston. Date of report, Dec. 21, '89.

RIDGWAY, *Elk Co.* (Pop., 1,100; est., 2,500.) On Clarion river. Engaged in tanning, and lumber trade. Incorp. borough. No sewers or electric lights.

History.—Built in '88. Engr., Horace Little. Work done by city.

Water Supply.—Mountain streams, one to three miles distant, by gravity.

Reservoir.—No data.

Distribution.—*Mains*, 8 to 4-in., about 5 miles. Pipe and specials from National Foundry & Pipe Works, Ltd., Scottdale, Pa. *Services*, not given. *Taps*, 65. *Meters*, not given. *Hydrants*, Mathews, 30. *Valves*, Kennedy's.

Consumption and *Pressure*, not given.

Financial.—Cost, $23,879. Bonded debt, $23,879. Int., 4%. Ann. op. exp. and ann. rev., not determined.

Management.—Secy., W. C. Healy. Supt., S. J. Barry.

RIDLEY PARK, *Delaware Co.* (Pop., est., 900.) Incorp. borough. No sewers. Has electric lights.

History.—Construction begun Feb. 17, '90, by Ridley Park Cold Spring Water Co. It was hoped that works would be in operation July 1, '90. Engrs., Wilson Bros. & Co., Philadelphia. Contrs., American Pipe Mfg. Co.

Water Supply.—Artesian wells and lake, pumping direct and to tank.

Pumping Machinery.—Dy. cap., 1,600,000 galls.; dup., make not given; 1,000,000 and two 300,000.

Tank.—Cap., 75,000 galls; 92 to 117 ft. above highest part of town.

Distribution.—*Mains*, 8 to 4-in. w. i., and cem.; pipe from Contrs. *Hydrants*, Ludlow, 20, *Valves*, Ludlow.

Pressure: Ordinary, 50 lbs. Fire, 80 lbs.

Financial.—Cost, about $25,000. Cap. stock, authorized, $25,000; paid up, $8,000. Hydrant rental, $25.

Management.—Prest., R. S. Pomeroy. Secy., H. H. Sawyer. Treas., F. E. Harrison. Date of report, Mar. 11, '90.

ROYERSFORD AND SPRING CITY, *Montgomery and Chester Cos.* (Pop.: Royersford, 558; est., 2,000. Spring City, est., 2,000.) On opposite sides Schuylkill river, 32 miles from Philadelphia. Manufactures stoves, glass, fire-brick, tile and wood pulp. Both incorp. boroughs. No sewers or electric lights.

History.—Built in '89-90 by Home Water Co., of Royersford; put in operation about Mar. 1, '90. Engr., Isaac S. Cassin.

Water Supply.—Artesian wells, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., [probably] 1,500,000 galls.; Gordon.

Stand-Pipe.—Cap., 184,000 galls.; 20 x 80 ft.

Distribution.—*Mains*, 12-in. down, 6 miles. Pipe from Mellert Foundry & Machine Co., Reading, and Donaldson Iron Co., Emaus; trenching and pipe-laying done by Caswell & Moore, Phœnixville. *Hydrants*, about 30.

Financial.—Cost, about $40,000. Cap. stock, authorized, $60,000. No debt. Hydrant rental, $20.

Management.—Prest., J. A. Buckwater. Secy., U. S. G. Finkbiner. Treas., S. B. Latshow. Date of report, Feb. 8, '90.

SAINT CLAIR, *Schuylkill Co.* (Pop., 4,149; est., 5,000.) On Mill creek, 3 miles from Pottsville, which see.

SAINT MARY'S, *Elk Co.* (Pop., 1,501; est., 3,000.) In coal and lumber district. No sewers or electric lights.

History.—Built in '89 by St. Mary's Water Co.; put in operation Nov., '89. Engr. and Contr., R. B. Thomas, Clarion.

Water Supply.—Silver creek, pumping to reservoir.

Pumping Machinery.—Dy. cap., about 300,000 galls.; from Young & Sacke, Titusville. *Boilers:* from Mc Ewen Bros., Ridgway.

Reservoir.—Cap., 150,000 galls.

Distribution.—*Mains*, c. i., 6 miles. *Services*, lead. Pipe and specials from R. D. Wood & Co., Philadelphia. *Hydrants*, Mathews, 25. *Valves*, Eddy.

Pressure, 95 lbs.

Financial.—Cost, $25,000. Cap. stock, authorized, $25,000. No debt. Ann. op. exp., $1,000. Hydrant rental, $25.

Management.—Prest., J. K. P. Hall. Secy., Geo. Widendorner. Treas., Chas. Luke. Date of report, Mar. 5, '90.

SAINT PETERSBURGH, *Clarion Co.* (Pop. 1,044; est., same.)

History.—Built about '75 by borough. Engr. and Contr., Daniel Whitling, St Petersburgh.

Water Supply.—Spring, 3 miles distant, by gravity. Originally Knowles pump. lifted water from well, but this supply has been abandoned.

Tanks.—Three; combined cap., 117,000 gals.

Distribution.—(In '87.) *Mains*, 4-in., material not given, about 3 miles. *Services*, ¾-in., material not given. *Taps*, 250. *Meters*, not given. *Hydrants*, Cameron, 15.

Consumption, about 20,000 galls. *Pressure:* Ordinary, 75 lbs. Fire, 100 lbs.

Financial.—(In '87.) Cost, $10,000. No debt. Ann. op. exp., $250. Ann. rev.: consumers, $300.

Management.—(In '88.) Com. of three: Jos. Krishner, C. O. Drive and Supt. Josiah Fillman.

NOTE.—No reply received to inquiries sent in '89.

SAYRE and ATHENS, *Bradford Co.* (Pop.: Sayre, 729; est., 3,000. Athens, 1,592; est., 3,000.) Villages about one mile apart on plain lying between Chemung and Susquehanna rivers, a short distance above their junction. Athens has large bridge works and Sayre has shops of the Lehigh Valley R. R. Co. Athens was settled in 1790, Sayre in '75.

History.—Built in '84 by Sayre Land Co. and leased to Sayre Water Co. Engr., C. W. Knight, Rome. All save pipe-laying and accompanying work was done by Co. See Water Supply.

Water Supply.—Susquehanna river, pumping to reservoir. In '89 two mains, a 6- and 8-in., were connected with two of similar size at Waverly, N. Y., to give each Co. an emergency supply. Mains of two Cos. were 6,000 ft. apart, and reservoirs, 3½ miles; Waverly reservoir 60 ft. above that at Sayre.

Intake Pipe.—From masonry chamber in river, 129 ft. of 20-in. c. i. pipe extends to shore, thence to pump-well 8 ft. in diam. and 32 ft. deep, bottom of the well being 7 ft. below low-water. From this well a 14-in. suction pipe connects with pumps.

Engine House.—Of brick, 32 x 56 ft., with chimney 6 ft. sq. at base and 60 ft. high.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Worthington comp., cond. *Boilers:* two, 4½ x 13 ft.; made at S. P. & N. Y. R. R. shops.

Reservoir.—Cap., 3,000,000 galls.; in excavation and embankment, in two compartments; surface, 191 ft. above Sayre, 200 ft. above Athens, 222 ft. above low-water in river. Compartments equal, rectangular, with rounded corners, greatest depth of water being 13½ ft. Banks rise 4 ft. above flow-line; inner slopes, 1½ to 1; outer, 2 to 1. Compartment first finished has bottom and slopes to within 2½ ft. of flow-line, covered 6 ins. of concrete on 6 ins. of puddle. Above concrete slopes have heavy wall of stone in cement extending to within 1½ ft. of flow-line, then dry stone wall carried 1 ft. above flow-line; slope finished with broken stone. Second basin not described. A 20-in. pipe connects two basins, and by valves in gate-house either or both reservoirs can be used, or water pumped to one and drawn from the other.

Force Main.—Pumps and reservoir both on east side of river, opposite villages, necessitating a pipe for 700 ft. beneath the river. A 10-in. pipe was laid to Sayre, and from this an 8-in. to Athens.

Distribution.—*Mains*, c. i., 10.4 miles. *Services*, w. i., lead. All pipe for original works above 6 ins., furnished by R. D. Wood & Co., Philadelphia, all below, by Sayre Pipe Foundry. Contrs. for pipe-laying, setting valves, hydrants and specials, Inman Bros., N. Y. City. *Taps*, 385. *Meters*, 24. *Hydrants*, Mathews, 48. *Valves*, Eddy.

Consumption, 450,000 galls. *Pressure*, 80 lbs.

Financial.—Cost, withheld, est., $80,000. No. debt. Ann. op. exp., withheld, est., $2,500. Ann. rev.: consumers, withheld, est., $8,000; cities, $2,400. Hydrant rental, $50.

Management.—Prest. and Supt., Howard Elmer. Secy. and Treas., Wm. Stevenson.

SCHUYLKILL HAVEN, *Schuylkill Co.* (Pop., 3,052; est., 5,000.) On Schuylkill river, 4 miles south of Pottsville and 31 northwest of Reading. Has railroad shops and manufactories. Incorp. No sewers or electric lights.

History.—Built in '84-5 by Schuylkill Haven Gas & Water Co. Des. Engr. Henry Steck. Const. Engr., Ed. McGinley. Contrs., American Construction Co., Philadelphia.

Water Supply.—Springs, four miles from town, by gravity; also emergency pumping.

Dam and Reservoir.—Cap., 8,000,000 galls. Dam not described.

Pumping Machinery.—Cap., not given; Worthington.

Distribution.—*Mains*, 8 to 4-in. c. i., 9 miles. *Services*, galv. i., lead. Pipe and specials from Mellert Foundry & Machine Co., Reading; laid by Jos. Gorman & Co. *Taps*, 300. *Meters*, none. *Hydrants*, Mellert, 27. *Valves*, Mellert.

Consumption, unknown. *Pressure*, 135 lbs.

Financial.—Cost, $75,000. Cap. stock, $100,000. Debt, $6,000. Int., 6%. Ann. op. exp., for both gas and water-works, $1,600. Ann. rev.: consumers, $7,500; city, not decided., owing to lawsuit. Hydrant rental, originally $20, but Council has refused to pay anything.

Management.—Prest., Caleb A. Horne. Secy., Geo. S. Moyer. Both of Philadelphia. Treas., Wm B. Reedy. Supt., W. H. Mellon.

SCRANTON, *Lackawanna Co.* (Pop., 45,850; est., 75,000.) On Lackawanna river, Roaring run and Stafford Meadow brook, in wide valley. Has extensive works for manufacture of steel, iron, locomotives and mining machinery. Has large anthracite coal trade. Settled in 1788; incorp. a borough in '56, city in '66. Has sewers and electric lights.

THE PROVIDENCE GAS AND WATER CO.

History.—Built in '67-8, and now supplies about 20,000 inhabitants. Des. Engr., E. W. Weston, Scranton. Const. Engr., O. D. Shepherd, Scranton. Work done by Co.

Water Supply.—Storage reservoirs on streams, by gravity.

Reservoirs.—Cap., 450,500,000 galls.; two storage, with cap. of 450,000,000 galls. and one small distributing, cap., 500,000 galls.

Distribution.—*Mains*, 35 miles of tarred iron: three lines, 8, 12 and 20-in.; latter extended in '89 with 24-in. pipe. *Services*, galv. i. *Taps*, 1,514. *Meters*, none. *Hydrants*, Ayers, Eddy, Ludlow, 70. *Valves*, kind, do.

Consumption, 2,500,000. *Pressure*, 75 to 120 lbs.

Financial.—Cost, withheld, est., $275,000. Stock, debt, int., withheld. Ann. op. exp., $2,500. Ann. rev.: consumers, $25,000; city, $1,000. Hydrant rental, $13.

Management.—Prest., W. R. Storrs. Secy. and Treas., H. F. Atherton. Supt., J. B. Fish.

SCRANTON GAS AND WATER CO.

History.—Built in '57 and enlarged in '71. Former work done by Jos. Battin, latter with C. E. Judson as Engr.

Water Supply.—Surface water, by gravity from impounding reservoir, with small reservoir and stand-pipe as equalizers of pressure.

First supply pumped from river, but in '66 this was so contaminated by sulphuric acid from mines that source was changed to Roaring run; drainage area above dam, 45 sq. m.

Supply introduced in '71 is from a mountain pond 19 miles distant, with an area of 196 acres, drainage area of 1 sq. m., and a cap. of 300,000,000 galls., and also from Roaring run, the outlet of the pond, there being a storage reservoir on the stream.

Old Storage Reservoir.—Cap., 80,000,000 galls.; formed by dam on stream; 1¼ miles from city, about 300 ft. above it, and 400 ft. above Lackawanna river.

New Storage Reservoirs.—One built in '87 on Oak run, with Burk Bros., Scranton, Contrs. Larger one built in '88 on Roaring run. E. Sherman Gould, Engr. of each.

Old Dam.—At first Roaring run reservoir, stone masonry, 320 ft. long, 35 ft. high, 8 ft. wide at top, 22 at bottom, except for 100 ft. of length, which is 35 ft. wide. Up-stream face, vertical; lower face batters 1 in 3. Spillway of cut stone, stepped, 100 ft. long.

Filter and Supply Pipes.—At old reservoir water passes to two 16-in. c. i. supply pipes through filter of sand and gravel.

Distributing Reservoir.—Cap., 1,000,000 galls.; 200 ft. above city.

Stand-Pipe.—Is 4 ft. in diam., with overflow; height not given.

Distribution.—(In '81.) *Mains*, c. i., 29.3 miles; originally of w. i. and cem. *Services*, galv. i. *Taps*, 1,047. *Meters*, none. *Hydrants*, kind not given, 106.

Consumption, about 5,000,000 galls. *Pressure:* Ordinary, 50 lbs. Fire, 125 lbs.

Financial.—(In '81.) Cost for gas and water-works, $680,000. Cap. stock, do., $456,000. No debt. Ann. op. exp., withheld, est., $2,500. Ann. rev.: consumers, withheld, est., $30,000; city, $3,000 for hydrants.

Management.—(In '88.) Prest., W. W. Scranton. Secy. and Treas. Geo. B. Hand. Supt., Robt. Reaves.

NOTE.—Repeated requests for data have been sent to this Co., but no response has been made since '81.

PEOPLE'S WATER CO.'S WORKS.

NOTE.—Supplies part of borough. See Minooka.

SELIN'S GROVE, *Snyder Co.* (Pop., 1,431; est., not given.) On Susquehanna river. Incorp. Has sewers. No electric lights.

History.—Built in '85-6 by Selin's Grove Water-Works Co. Engr., Fred Dittman, Williamsport. Contr., P. Herdic, deceased.

Water Supply.—Penn's creek, a mountain stream, pumping to reservoir and direct.

Pumping Machinery.—Dy cap., 1,000,000 galls.; Knowles comp., cond. *Boiler:* steel horizontal tubular.

Reservoir.—Cap., 1,000,000 galls.; 189 ft. sq. x 18 ft. deep; puddled with clay; 110 ft above highest part of town. Engr., H. E. Richter.

Distribution.—*Mains*, c. i., 5 miles. *Services*, not given. *Taps*, withheld, est., 220. *Meters*, not given. *Hydrants*, kind not given, 30.

Consumption, 100,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 60 to 100 lbs.

Financial.—Cost, withheld, est., $40,000. Bonded debt, $25,000. Int., 5%. Ann. op. exp., $600. Ann. rev.: consumers, withheld, est., $3,000; city, $1,150. Hydrant rental, $40 for 25; remainder, $30.

Management.—Prest., H. B. Milick. Secy. and Treas., H. Hinckly. Supt., T. Kocher.

SEWICKLEY, *Allegheny Co.* (Pop., 2,053; est., 3,500.) On Ohio river. No sewers or electric lights.

History.—Built in '70-1 by borough. Engrs., Edeburn & Cooper

Water Supply.—Springs, by gravity to and from reservoir, and, in dry weather only, pumping from wells near river. Water is conveyed from springs to reservoir by 375 ft. of 15-in. earthenware pipe. There are four 10-in. wells, at river, 30 ft deep, driven in gravel 100 ft. from river. Suction pipe connects wells and pumps. Two wells at reservoir, 100 and 300 ft. deep.

Reservoir.—Cap., 4,000,000 galls.; in excavation and embankment, lined with puddled clay; sides paved with brick covered with cem. Is 100 ft. above borough.

Pumping Machinery.—Dy. cap., 388,000 galls.; two Worthington dup., 9x5½x10 ins. Pumps set 45 ft. from surface in 12-ft. well. *Boiler*: upright.

Distribution.—*Mains*, 12 to 3-in. c. i., 238 ft. 15-in. tile, total, 9 miles. *Services*, galv. i., lead. *Taps*, about 443. *Meters*, 1. *Hydrants*, Hutchinson & Alexander, 38. *Valves*, kind, do., and Jesse W. Starr & Sons'.

Consumption, 150,000 galls. *Pressure*, 45 lbs.

Financial.—Cost, about $100,000. Debt, $75,000: $60,000 at 8%, $15,000 at 6%, Ann. op. exp., $950. Ann. rev.: consumers, $6,802; ice, $130; city, none Rev. in '75, $1,401; in '80, $3,641.

Management—Five Comrs., Secy., Thos. Dickson. Supt., Jno. Patton, Jr.

Reference.—For description of wells and pumping plant see *Eng. News*, vol. XXII., p. 100.

SHAMOKIN BOROUGH and COAL TOWNSHIP, *Northumberland Co.* (Pop.: Shamokin, 8,124; est., 1,500. Coal, 4,320; est., 10,000. Pop. supplied, est., 20,000.) Shamokin is on Shamokin creek, in the anthracite coal regions, and Coal is surrounding township. Shamokin is P. O. for both places. Incorp. borough in '36. No sewers. Has electric lights.

History.—Built in '73-4 by Shamokin Water Co. In '86 Roaring Creek Water Co. put in gravity line from Roaring creek, furnishing principal supply to Shamokin Water Co. In '88 Anthracite Water Co. built works, with A. B. Cochran, Pottsville, Const. Engr. The Roaring Creek and Anthracite Water Cos. are under one management. The Shamokin Water Co. has extended its mains for various distances into Coal Township, under name of Coal Water Co. [As we understand it, various Cos. are practically under one management.]

Water Supply.—Roaring creek and Trout run, mountain streams, by gravity, supplemented in dry weather by pumping from Eagle run.

Pumping Machinery.—No data.

Dams and Reservoirs.—Cap., 45,000,000 galls. Five. *Roaring Creek:* cap., 5,000,000 galls.; area, 5 acres; elevation, 280 ft. above Market St. at railway crossing. Dam of clay, 10 to 12 ft. high, sheet-piled; inner slopes, ripra pped. *Trout Run Nos.* 1, 2, 3: cap., est., 5,000,000 galls.; area, about 3 acres; av., one acre each. Dams of earth, sheet-piled; inner slopes riprapped. *Trout Run No.* 4: cap., 35,000,000 galls.; area, 12 acres; elevation, 90 ft. Dam of earth, 500 ft. long, 21 ft. high, 21 ft. wide on top; sheet-piled with 3-in. oak plank. Both slopes riprapped.

Supply Mains.—*Roaring Run:* 5 miles 16, 4 miles 14-in. c. i. See Tunnels. *Trout Run:* from No. 4, 12-in.; length, not given.

Tunnels.—On Roaring run conduit, 3,300 and 900 ft. long.

Distribution.—*Mains*, c. i., 35 miles. *Services*, galv. i. *Taps*, 1,300. *Meters*, 4. *Hydrants*, Mathews, Tamaqua, 43. *Valves*, Eddy, Chapman, but mostly Ludlow; latter now used exclusively.

Consumption, 2,000,000 galls. *Pressure*, av., 100 lbs.

Financial.—Cost, $500,000. Debt, $124,000. Int., 4 and 5%. Ann. op. exp., $6,000. Ann. rev.: consumers, withheld, est., $35,000; city, $860. Hydrant rental, $20.

Management.—Prest., W. C. McConnell. Treas., C. Q. McWilliams. Secy., Geo. O. Martz.

SHARON, *Mercer Co.* (Pop., 5,684; est., 9,000.) Engaged in coal mining and iron manufacturing. Incorp. borough. Has sewers and electric lights.

History.—Built in '85 by Sharon Water-Works Co. Engr., Ellis Morrison. Contr., Samuel R. Bullock. Both of N. Y. City.

Water Supply.—Chenango river, pumping to reservoir.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two Deane comp., cond., dup.

Reservoir.—Cap., 1,500,000 galls.

Distribution.—*Mains*, c. i., 10 miles. *Services*, w. i., lead. *Taps* (in '87), 398. *Meters* (in '87), 4. *Hydrants*, Ludlow, 80. *Valves*, Ludlow.

Consumption, est., 400,000 galls. *Pressure*, 150 lbs.

Financial.—Cost, $300,000. Cap. stock, $200,000. Bonded debt, $100,000. Int., 6%. Ann. op. exp. (in '87), $3,000. Ann. rev.: consumers (in '87), $7,150; city, $4,000. Hydrant rental, $50.

Management.—Prest., H. S. Hopper. Secy. and Treas., Walter Wood, Philadelphia. Supt., E. J. Robinson.

SHARPSBURGH, *Allegheny Co.* (Pop., 3,466; est., 5,000.) On Allegheny river in coal region; has furnaces, foundries and rolling mills. Incorp. Has electric lights.

History.—Built in '86 by borough. Engr. and Contr., Jacob Schellner.

Water Supply.—Allegheny river, by direct pumping.

Pumping Machinery.—Cap., 2,200,000 galls.; two Gordon & Maxwell dup., high-pressure plunger.

Distribution.—*Mains*, c. i., 7½ miles. *Services*, not given. Pipe from Buffalo C. I. Pipe Co., Buffalo, N. Y. *Taps*, 500. *Meters*, none. *Hydrants*, from Bailey, Farrell & Co., Pittsburgh, 41. *Valves*, kind, do.

Consumption, 420,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 80 lbs.

Financial.—Cost, $54,000. Bonded debt, $50,000. Int., 5%. Ann. op. exp., $3,400. Ann. rev.: consumers, $6,500.

Management.—Supt., George Fitch.

SHENANDOAH, *Schuylkill Co.* (Pop., 10,147; est., 18,000.) In anthracite coal region, a number of largest colleries being within borough limits. Has electric lights.

History.—Built in '70 by Shenandoah Water Co. No Engr. or Contr.

Water Supply.—Mountain springs, by gravity.

Reservoir.—Cap., not given; area, 10 acres.

Distribution.—(In '87.) *Mains*, c. i., 13 miles. *Services*, lead. *Taps*, not given. *Meters*, none. *Hydrants*, kind not given, 41; put in by borough.

Consumption, not given. *Pressure*, 75 to 120 lbs.

Financial.—(In '87.) Cost, $150,000. Cap. stock, $50,000. No debt. Ann. op. exp., withheld, est., $1,500. Ann. rev.: consumers, said to be $700; city, not given.

Management.—(In '88.) Prest., John Cather. Secy., J. O. Roads. Treas., Tom Grant. Supt., S. D. Hess.

NOTE.—No replies received to inquiries sent in '89.

SHICKSHINNY, *Luzerne Co.* (Pop., 1,058; est., 2,000.) A mining and railroad center. Incorp. No sewers or electric lights.

History.—Built in '84 by Shickshinny Water Co. No Contr.

Water Supply.—Shickshinny creek, fed by springs, by gravity.

Distribution.—*Mains*, c. i., 2½ miles. *Services*, w. i. *Taps*, 250. *Meters*, none. *Hydrants*, 1.

Consumption, 300,000 galls.; large part of water used by West End Coal Co., Penn., and D., L. & W. R. R. Cos. *Pressure*, 100 ft. head, which can be increased to 210 ft.

Financial.—Cost and cap. stock, $11,200. No debt. Ann. op. exp., $100. Ann. rev.: consumers, $1,100.

Management.—Prest., Geo. W. Search. Secy. and Supt., M. B. Hughes. Treas. Jesse Beadle.

SHIPPENSBURGH, *Cumberland Co.* (Pop., 2,213; est., 2,500.) In grazing and agricultural district. No sewers or electric lights.

History.—Built in '86 by borough. Engr., F. H. Thomas, Shippensburgh.

Water Supply.—Mountain springs, by gravity.

Reservoirs.—Cap., 700,000 galls.; 100x150 ft.

Distribution.—*Mains*, c. i., 9 miles. *Services*, galv. i. *Taps*, 211. *Meters*, none. *Hydrants*, Ludlow, 43. *Valves*, Ludlow.

Consumption, 100,000 galls. *Pressure:* Ordinary, 67 lbs. Fire, 80 lbs.

Financial.—Cost, $26,000. Bonded debt, $26,000. Int., 4%. Ann. op. exp., $150. Ann. rev.: consumers, $1,600.

Management.—Supt., B. F. Landis.

SLATINGTON, *Lehigh Co.* (Pop., 1,634; est., 2,500.) On Lehigh river, divided by Trout creek into upper and lower towns. In slate region. Settled in '50; incorp. a borough in '61. No sewers Has electric lights.

OLD WORKS.

General Description.—Built in '61 by Slatington Water Co. Supply from springs, collected in covered reservoir, 40 x 70 ft., 30 ft. above upper, 125 ft. above lower, town.

In '81 there were 3 miles of pipe, 150 taps, no hydrants. Cap. stock was $6,000, and works had cost $10,000. In '80 the exp. were $100; receipts, $900. In '83 borough bought Co.'s rights, plant and stock, and destroyed latter.

BOROUGH WORKS.

History.—Built in '83. See above. Des. Engr., S. D. Lehr, Allentown. Const. Eng., Jno. D. Emack, Slatington. Contrs., Ringer & Kunner, Slatington.

Water Supply.—Mountain springs, by gravity.

Reservoir.—Is 10 x 12 ft.

Distribution.—*Mains*, c. i., 6½ miles. *Services*, lead. *Taps*, 337. *Meters*, one. *Hydrants*, Mathews, 28. *Valves*, Eddy.

Consumption, est., 324,000 galls. *Pressure*, 200 lbs.

Financial.—Cost, $26,635. Bonded debt, $26,635. Int., 4%. Ann. op. exp., $150. Ann. rev.: total, $2,500.

Management.—Three Comrs. Prest., L. Campbell. Treas., E. D. Peters. Secy., Geo. McDowell.

SMETHPORT, *McKean Co.* (Pop., 872; est., 1,200.) In petroleum and mining region. Incorp. No sewers or electric lights.

History.—Built in '81 by Smethport Water Co. Des. Engr., S. V. Godder, Lake George, Fla. Const. Engr., Directors of Co. Contrs., E. H. Cook & Co., Elmira, N. Y.

Water Supply.—Springs, by gravity.

Dam and Reservoir.—Cap., est., 375,000 galls.; area, about ½ acre; av. depth, 5 ft. Dam of stone masonry, with heart-wall; 80 ft. long, 12 ft. high, 4 ft. wide on top, 11 at bottom; founded on clay. *Heart-wall:* concrete. *Spillway:* in center of dam, free, size not given. *Discharge-pipe:* 16-in. Dam perfectly tight. Built in 81. Des. Engr., Wm. Haskill. Const. Engr., Ed. Waller. Contr., Jno. Carlson. Cost, $2,000. In '89 it was proposed to double cap. by raising dam 4 ft.

Distribution.—*Mains*, 6-in. c. i., 5¼ miles. *Services*, w. i., lead. Pipe and specials from Gloucester Iron Works, Philadelphia. *Taps*, about 200. *Meters*, none. *Hydrants*, Philadelphia, 30.

Consumption, unknown. *Pressure*, 55 lbs.

Financial.—Cost, $20,000. Cap. stock, $9,500. No debt. Ann. op. exp., $300. Ann. rev.: consumers, $2,000; city, $300. Hydrant rental, $20.

Management.—Prest., Henry Hamlin. Secy., Treas., Supt., A. B. Armstrong.

SOUTH BETHLEHEM and WEST BETHLEHEM, *Northampton Co.* (Pop.: So. Bethlehem, 4,925; est., 7,000. West Bethlehem, est., 3,000. Total, est., 10,000.) On Lehigh river. South Bethlehem has steel, zinc, brass and boiler works, silk and knitting mills, and deposits of zinc and iron ore. No sewers or electric lights.

History.—Built in '85-6 by Bethlehem South Gas & Water Co. No Engr.

Water Supply.—Lehigh river, pumping to reservoir.

Intake Crib and Pipe.—Stone crib built 60 ft. from shore; from this 20-in. pipe leads to pump-well.

Pump Well and Buildings.—Pump-well is 4 by 40 ft., by about 6 ft. deep. Engine house on foundation, which raises floor 23 ft. above river. Stone, 25 x 45 ft., x 20 ft. high. Boiler house, 38 x 40 ft., x 20 ft. high.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; vertical comp., cond., beam and fly-wheel engine and dup. vertical pumps, made by Dickson Mfg. Co., Scranton. *Boiler:* horizontal tubular.

Reservoir.—Cap., 3,000,000 galls.; in two compartments, separated by bank 6 ft. wide on top, 70 ft. at bottom. One compartment 52 x 131 ft. at bottom, with slopes of 2 to 1. Other compartment has about the same cap., but is irregular in shape, and slope of banks. Sides and bottoms covered with 1 ft. of puddled clay, above which is 1 ft. of concrete. All pipes passing through banks packed in puddled clay One compartment used for a settling basin.

Supply Mains.—A 12-in. pipe crosses the river to West Bethlehem, and a 10-in. pipe leads to South Bethlehem.

Distribution.—*Mains*, 14 miles. *Services*, lead. Pipe and specials from Mellert Foundry & Machine Co., Reading, and Donaldson Iron Co., Emaus; trenching and pipe laying by A. H. Coon & Co., Pittston. *Taps*, 714. *Meters*, 3. *Hydrants*, Mathews, Adams, 72 *Valves*, Ross.

Consumption, 700,000 galls *Pressure*, 85 to 100 lbs.

Financial.—Cost, $150,000. Cap. stock, $140,000 Bonded debt, $34,500. *Stock and bonds cover both gas and water-works.* In '88 Co. reported 6% dividends on stock, and 7% on bonds. Ann. op. exp., withheld, est., $2,200. Ann. rev.: consumers, withheld, est., $14,000; city, about $1,800. Hydrant rental, $15.

Management.—Prest., E. P. Wilbur. Treas., H. S. Goodwin. Supt., B. E. Lehman.

SOUTH EASTON, *Northampton Co.* (Pop., 4,534; est., 6,200.)

History.—Built in '86-8 by South Easton Water Co. Engr. and Contr., J. Marshall Young, Easton.

Water Supply.—Tunnel, 351 ft. into mountain, by gravity. Dy. yield, 70,000 galls.

Reservoir.—Cap., 750,000 galls.; 100 ft. sq. Sub-contrs., L. M. Lesher & Son, Easton. Cost, $6,600.

Distribution.—*Mains*, 8, 6 and 4-in. c. i., 5½ miles. *Services*, ¾-in. galv. w. . Pipe and specials from Warren Foundry & Machine Co., Phillipsburgh, N. J.; pipe laid by L. M. Lesher & Son, Easton. *Taps*, 250. *Meters*, none. *Hydrants*, Ludlow, 19. *Valves*, Ludlow.

Consumption, 40,000 galls. *Pressure*, 45 to 93 lbs.

Financial.—Cost $40,000. Cap. stock, $20,000. Debt, $18,000; bonds, $10,000 at 5%; notes, $8,000. Ann. op. exp., $100. Ann. rev.: consumers, $1,000; city, $600. Hydrant rental, $25, a 5-years contract.

Management.—Prest., W. F. Pascoe. Secy., J. Frank Andrews. Treas. and Supt., Jno. Stewart.

SPRING CITY, *Chester Co.* See Royersford.

STROUDSBURG, *Monroe Co.* (Pop., 1,860; est., 2,500.) On Broadhead s creek in agricultural region; has water-power. Settled in 1739.

History.—Built in '76 by Stroudsburg Water Co., after plans by Dr. J. Albert Cloud.

Water Supply.—Springs, by gravity.

Distribution.—*Mains*, 4 and 6-in. c. i., 3½ miles. *Services*, galv. 1. *Taps*, 225. *Meters*, none. *Hydrants*, kind not given, 14; not used.

Consumption, 6,000 galls. *Pressure*, 57 lbs.

Financial.—Cost, $15,900. Cap. stock, $15,000. Debt, $900. Int., 5%. Ann. op. exp., $300. Ann. rev.: consumers, $1,400.

Management.—Prest., Jno. B. Storm. Secy., Jno. S. Brown. Treas., Andrew N. Snover. Supt., Frederick Phillips.

SUMMIT HILL, *Carbon Co.* (Pop., 1,763; est., 2,200.) Engaged in coal mining.

History.—Built in '76 by Summit Hill Water Co. Engr., J. C. Rutter, Lansford.

Water Supply.—Mountain stream, pumping to reservoir.

Pumping Machinery.—Dy. cap., 30,000 galls.; Carter & Allen dup.

Force Main.—Rise, 500 ft.

Reservoir.—Cap., 281,250 galls.; is 30x125 ft., x10 ft. deep.

Distribution.—(In '87.) *Mains*, c. i., 4 miles. *Services*, galv. i. Pipe and specials from Warren Foundry & Machine Co., Phillipsburgh, N. J. *Taps*, 175. *Meters*, none. *Hydrants*, Ludlow, 18. *Valves*, Ludlow.

Consumption, not given. *Pressure*, 45-ft. head.

Financial.—Cost (in '87), $13,000. Cap stock (in '88), $10,000. No debt. Ann. op. exp. (in '84), 1,300. Ann. rev.: consumers (in '84), $2,100; city, not given.

Management.—(In '88.) Prest and Supt., Saml. Rickert. Secy. Jas. McReady.

NOTE.—No reply received to inquiries sent in '89.

SUNBURY, *Northumberland Co.* (Pop., 4,077; est., 7,500.) On Susquehanna river. Has rolling mill, nail works, organ factory, steam saw mills, car and machine shops, coffin, door and sash factories. Incorp. No sewers. Has electric lights.

History.—Built in '83-4 by Sunbury Water Co.

Water Supply.—Surface and spring water, pumping from impounding to distributing reservoir.

Pumping Machinery.—Cap., 2,500,000 galls.; two Worthington. *Boilers:* Horizontal tubular.

Dam and Reservoirs.—*Impounding:* cap., 700,000 galls.; formed by dam across creek. *Distributing:* cap., 4,000,000 galls.; in excavation and embankment, 13 ft. deep; inner slopes and bottom puddled, then covered with 1 ft. of broken stone; one mile from, and 131 ft. above, town.

Distribution.—*Mains*, c. i., 11 miles. *Services*, galv. i. *Taps*, 450. *Meters*, 2. *Hydrants*, Mathews, 40. *Valves*, Peet.

Consumption, 750,000 galls. *Pressure*, 56 lbs.

Financial.—Cost, $110,000. Cap. stock, $33,000. Bonded debt, $77,000. Int., 6%. Ann. op. exp., $2,000. Ann. rev.: consumers, $9,000; city, $1,200. Hydrant rental, $30.

Management.—Prest., Jno. Haas. Secy., S. E. Slaymaker. Treas., L. T. Rohebach.

SUSQUEHANNA, *Susquehanna Co.* (Pop., 3,467; est., 5,000.) On Susquehanna river, on hilly land. Has repair shops. Settled in '40. Incorp. No sewers or electric lights.

History.—Built in '74 by Susquehanna Water Co.

Water Supply.—Springs, by gravity.

Reservoir and Conduit.—Water taken from pond 60 ft. in diam., filled by springs, and conveyed by 6-in. c. i. pipe to a reservoir 30 ft. in diam. and 4½ ft. deep, built of round stone in cem.

Distribution.—*Mains*, c. i., 0.8 miles; 1 mile added in '89. *Services*, galv. i. *Taps*, 100. *Meters*, none. *Hydrants*, Mathews, 5.

Consumption, unknown. *Pressure*, 40 lbs.

Financial.—Cost, $6,000. Cap. stock, $5,000. No debt. Ann. op. exp., $100. Ann. rev.: consumers, $900; city, none. Hydrant rental, free.

Management.—Prest., Gaylord Curtis. Secy. and Treas., C. F. Curtis.

TACONY, *Philadelphia Co.* (Pop., est., 5,000.) A suburb and branch P. O. of Philadelphia, on Delaware river. Has large saw and tile works, also rope manufactory.

History.—Built in '78-9 by Disston Water Co., in connection with factory and real estate interests of Henry Disston & Sons. Engr., Saml. Bevan, Tacony, present Supt. Work done by Co.

Water Supply.—Delaware river, pumping direct and to tank.

Pumping Machinery.—Dy. cap., 1,000,000 galls; Worthington.

Tank.—Cap., 55,000 galls.

Distribution.—*Mains*, c. i., 6 miles. *Services*, lead. Pipe and specials from Gloucester Iron Works, Philadelphia. *Taps*, 600. *Meters*, none. *Hydrants*, kind not given, 48.

Consumption, 1,250,000 galls. *Pressure:* Ordinary, 48 lbs. Fire, 130 lbs.

Financial.—Cost, withheld, est., $80,000. No debt. Ann. op. exp. withheld, est., $1,800. An. rev.: consumers, withheld, est., $7,000; city, not given.

Management.—Prest., Hamilton Disston. Treas., Jacob S. Disston. Supt., Saml. Bevan.

TAMAQUA, *Schuylkill Co.* (Pop., 5,730; est., 7,000.) On Little Schuylkill river, in coal region, 16 miles from Pottsville. Has manufactories. Has electric lights.

History.—Built in '51 by borough. Des. Engr., David Goodman, deceased. Const. Engr., B. T. Hughes, Tamaqua. No Contrs. for labor.

Water Supply.—Rabbit run and Owl creek, by gravity from impounding reservoirs.

Dams and Reservoirs.—Cap., 20,000,000 galls. *Rabbit run:* cap., 10,000,000 galls.; built in '51. *Owl creek:* cap., 10,000,000 galls.; built in '83.

Distribution.—*Mains*, 10 to 2-in. c. i., 10 miles. *Services*, w. i., lead. *Taps*, 1,250. *Meters*, none. *Hydrants*, 75; Cassin used to '82, Adams since. *Valves*, kind not given.

Consumption, not given. *Pressure*, 80 lbs.

Financial.—Cost, about $68,000. Debt, not separable from borough debt, $44,300 Int., 4½%. Ann. op. exp., about $1,200. Ann. rev.: consumers, $7,000.

Management.—Borough Council. Supt., Frank Lynch. Report by T. D. Boone.

TARENTUM, *Allegheny Co.* (Pop., 1,245; est., 3,000.) On Allegheny river and Bull creek, 20 miles from Pittsburgh. Has natural gas wells and considerable trade. Incorp. in '32. No sewers. Has electric lights.

History.—Built in '86 and extended in '88. In '86 H. M. Brackenridge laid pipe along a few streets and supplied about 100 families, water being taken from springs. In '88 Tarentum Water Co. was organized, bought existing works, and extended them. Const. Engr. and Contr. for latter, Jas. H. Harlow, Pittsburgh.

Water Supply.—Springs, pumping to reservoir.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Smith & Vaile.

Reservoir.—Cap., 500,000 galls.

Distribution.—*Mains*, c. i., 7¼ miles. *Services*, not given. *Taps*, 177. *Meters*, none, *Hydrants*, 1.

Consumption, 30,000 galls. *Pressure*, 85 lbs.

Financial.—Cost, $46,000. Cap. stock, $50,000. Bonded debt, $25,000. Int., 6%. Ann. op. exp., not given, est., $800. Ann. rev.: consumers, about $3,240; city, none.

Management.—Prest., J. B. Ford. Secy. and Treas., Jno. W. Hemphill. Supt., Felix N. McDowell.

TAYLORVILLE, *Lackawanna Co.* (P. O., Scranton.) See Minooka.

TIDIOUTE, *Warren Co.* (Pop., 1,255; est., 1,600.) Engaged in manufacturing.

History.—Built in '71 by Tidioute Water Co.

Water Supply.—Mountain stream, fed by springs, by gravity from impounding to distributing reservoir.

Dam and Reservoirs.—*Impounding:* cap., not given; formed by dam four miles from town. *Distributing:* cap., 520,000 galls.; 160 ft. above town.

Distribution.—(In '87.) *Mains*, c. i., 9 miles. *Services*, galv. i. *Taps*, 135. *Meters*, none. *Hydrants*, Mathews, 27. *Valves*, Ludlow.

Consumption, not given. *Pressure*, 65 lbs.

Financial.—(In '87.) Cost, $40,000. Cap. stock, $26,000. Bonded debt, $1,200. Int., 4%. Ann. op. exp., $500. Ann. rev.: consumers, withheld, est., $3,500; city, $500. Hydrant rental, $14.81.

Management.—(In '88.) Prest., Theo. W. Irwin. Treas., H. H. Cummings. Secy., Wm. R. Dawson. Supt. M. C. Bowen.

NOTE.—No reply received to inquiries sent in '89.

TIOGA, *Tioga Co.* (Pop. 520.) Incorp. No sewers or electric lights.

History.—Built in '74 by T. A. & C. H. Wickham; in '88 Tioga Water-Works Co. was incorp. and now controls the works. Engr., C. H. Wickham. Flood of June 1, 89, swept away office, with books and papers.

Water Supply.—Beatty creek, by gravity from impounding to distributing reservoir. In case of serious drought pumping is used. Creek is mountain stream, fed by springs; drainage area, 9 sq. m.

Dam and Impounding Reservoir.—Cap., 14,000,000 galls.; area, 1½ acres; located on mountain. Dam of heavy clay, with heart-wall: about 200 ft. long, 20 ft high, 16 ft. of water, 50 ft. thick at base. Slopes unpaved. *Heart-wall:* about 20 ft. from foot of inner slope, 16 ft. high; two rows double sheet-piling, 4 ins. apart, filled between with blue clay mixed with water until it would pour; sheet-piling also driven below center of heart-wall. *Spillway:* 14 ft. wide, beginning above dam, carried around dam through clay excavation; lined with boards, double; free; slope, 1 to 10 at first, then 1 to 4. *Discharge-pipe:* 12-in.; slope, 1 to 20. Has branch waste-pipe, with gate located below dam and above gate on supply-main. Built in '80, by the day. Cost, not separated from other expenses.

First reservoir had cap. of 3,000,000 galls.; was formed by a timber dam.

Old Filter.—At first impounding reservoir; sand and charcoal in a wooden crib.

Conduit.—*Old:* to distributing reservoir; 6-in., banded staves. *New:* [probably] 12-in.

Distributing Reservoir.—Cap., about 1,000,000 galls.; is near town, 100 ft. sq. at top, 80 at bottom, and 15 ft. deep.

Pumping Machinery.—Dy. cap., not given; Worthington dup.

Distribution.—*Mains,* Wyckoff, 3.2 miles. *Services,* galv. i. *Taps,* withheld, est., 100. *Meters,* none. *Hydrants,* Ayers, 14.

Consumption, 300,000 galls. *Pressure,* 40 to 90 lbs.

Financial.—Cost, $20,000. Cap. stock, $15,000. No debt. Ann. op. exp. (in '80), $250. Ann. rev.: consumers, withheld, est., $1,500; city, $35℄. Hydrant rental, $25.

Management.—Prest., E. G. Schieffelin. Secy., Treas. and Supt., T. A. Wickham.

TITUSVILLE, *Crawford Co.* (Pop., 9,046; est., 9,500.) On Oil creek, on sloping ground surrounded by hills about 100 ft. high. Engaged in refining and selling oil, manufacturing boilers, artesian and oil well machinery, flour and fruit barrels, brooms and furniture. Incorp. city in '66. Has electric lights.

History.—Built in '73 by city. Const. Engr., M. E. Bassett.

Water Supply.—Wells, direct pumping. Two wells 15 ft. in diam. by 22 ft. deep, and one driven well 10 ins. in diam. and 60 ft. deep, from which water flows to others. Wells are in gravel stratum.

Pumping Machinery.—Cap., 2,000,000 galls.; Holly quadruplex and rotary. *Boilers:* 80 and 50-H. P.; one Holly tubular, one 80-H. P., made in Titusville.

Distribution.—(In '87.) *Mains,* c. i., 11.05 miles. *Services,* w. i. *Taps,* 850. *Meters,* 25. *Hydrants,* Holly, 66. *Valves,* Ludlow.

Consumption (in '87), 1,000,000 galls.; *Pressure:* Ordinary, 25 lbs. Fire, 90 lbs.

Financial.—(In '87.) Cost, $139,292. Debt, $112,600. Int., 4, 6 3-10, 7 and 8%. Ann. op. exp., $5,600. Ann. rev.: total, $12,000.

Management.—Supt. and Secy., G. W. Angier.

NOTE.—No reply received to inquiries sent in '89.

TOWANDA, *Bradford Co.* (Pop., 3,814; est., 5,000.) On Susquehanna river. Manufactures nails, boots and shoes and furniture. Incorp. No sewers or electric lights.

History.—Built in '79 by Towanda Water-Works Co.

Water Supply.—Surface water by gravity, and river by pumping.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Gaskill dup. *Boiler,* 80-H. P. arched tubular.

Distribution.—*Mains,* c. i. (in '87), 8 miles. *Services,* w. i. *Taps* (in '87), 400. *Meters,* none. *Hydrants,* Mathews, 50. *Valves,* Ludlow.

Consumption (in '87), 400,000 galls. *Pressure,* 95 lbs.

Financial.—Cost, withheld, est., $80,000. Debt and int., withheld, Ann. op. exp., withheld, est., $1,800. Ann. rev.: (in '87) consumers, $6,000; city, $2,500. Hydrant rental, $50.

Management.—Prest. and Supt., J. J. Griffiths. Secy., Frank K. Daniels. Treas., Winthrop Pond.

TREMONT, *Schuylkill Co.* (Pop., 1,785; est., 2,200.) Is 13 miles from Pottsville; engaged in coal mining and iron manufacturing. Incorp. borough. No sewers or electric lights.

History.—Built in '66, it is not stated by whom, and operated since '74 by Tremont Water & Gas Co. Const. Engr., Price Wetherill.

Water Supply.—Small mountain stream, and springs, by gravity.

Reservoir.—Cap., 1,000,000 galls.; stone and earth.

Distribution.—*Mains*, c. i., about 2¼ miles. *Services*, galv. i., lead. Pipe and specials from Mellert Foundry & Machine Co., Reading. *Taps*, 150. *Meters*, none. *Hydrants*, Mellert, 4. *Valves*, Mellert. *Close of '70*: Mains, 3,000 ft. Taps, 20. Hydrants, none. *Close of '80*: Mains, 2 miles. Taps, 50. Hydrants, 3.

Consumption, 20,000 galls. *Pressure*, 50 to 60 lbs.

Financial.—Cost, $26,000. Cap. stock, issued, $10,480; authorized, $40,000. Bonded debt, $13,000. Int., 5%. Ann. op. exp., $75. Ann. rev.: consumers, $900; city, $45. Hydrant rental, about $11. Cost, close '70, $6,000. Do., '80, about $26,000. Rev., '70, $250. Do., '80, $400.

Management.—Prest., and Supt., I. P. Bechtel. Secy., W. W. Stewart. Treas., C. B. Sillyman.

TROY, *Bradford Co.* (Pop., 1,241, est., 1,500.) In agricultural and dairying district, 25 miles from Elmira, N. Y. Incorp. No sewers or electric lights.

EDGEWOOD WATER CO.

History.—Built in '80; not incorp.

Water Supply.—Springs, by gravity; dy. flow, 150,000 galls.

Distribution.—(July 1, '89.) *Mains*, kind not given, 4 miles. *Services*, not given. *Taps*, 150. *Meters*, none. *Hydrants*, Ludlow. *Valves*, Ludlow.

Consumption, 100,000 galls. *Pressure*, 80 lbs.

Financial.—Cost, $15,000. Debt, none. Ann. op. exp., about $400. Ann. rev.: withheld, est., $2,000; city, not given. Hydrant rental, not given.

Management.—Prest., N. S. McReem. Secy., Treas., Supt., R. J. Redington.

TROY WATER CO.

History.—Built in '80.

Water Supply.—Springs, by gravity. In '89 were experimenting with driven wells.

Distribution.—*Mains*, kind not given, 2 miles. *Services*, not given. *Taps*, 200. *Meters*, none. *Hydrants*, Ludlow, 3. *Valves*, Ludlow.

Consumption, 100,000 galls. *Pressure*, 25 lbs.

Financial.—Cost, $4,000. Debt and int., not given. Ann. op. exp., withheld, est., $500. Ann. rev.: consumers, withheld, est., $2,500.

Management.—Address E. B. Parsons.

TUNKHANNOCK, *Wyoming Co.* (Pop., 1,241; est., 2,500.) On Susquehanna river at mouth of Tunkhannock creek, in valley surrounded by hills. Elevation of the town varies about 40 ft. Settled in 1780; incorp. borough in '45. No sewers or electric lights.

History.—Built by Slocum Spring Water Co. in '59, and rebuilt in '70 after plans by Harvey Sickler. Charter perpetual. Contrs. for rebuilding, R. D. Wood & Co., Philadelphia.

Water Supply.—Slocum spring and Susquehanna river, pumping to reservoir.

Pumping Machinery.—Dy. cap., 500,000 galls.; Worthington, Gordon & Maxwell.

Filter.—Dy. cap., 300,000 galls; Hyatt.

Reservoir.—Cap., 600,000 galls.

Distribution.—*Mains*, c. i., 6 miles. *Services*, w. i. *Taps*, 150. *Meters*, none. *Hydrants*, Mathews, 27. *Valves*, kind, do.

Consumption, unknown. *Pressure*, 40 to 60 lbs.

Financial.—Cost, $30,000. Cap. stock, debt, int., withheld. Ann. op. exp., withheld, est., $1,000. Ann. rev.: consumers, withheld, est., $2,500; city, about $400. Hydrant rental, $15, 3-years contract.

Management.—Prest., Geo. A. Vail, N. Y. City. Secy., Henry Harding. Treas. and Supt., Wm. C. Kittredge.

TUNKHANNOCK WATER CO.'S PLANT.

General Description.—Co. operates works, but has not replied to inquiries. Secy. and Treas., F. C. Ross.

TYRONE, *Blair Co.* (Pop., 2,678; est., 4,500.) On north fork of Juniata river, on uneven ground at the foot of the Allegheny mountains. Engaged in iron, lime, leather, paper, lumber and bituminous coal trade. Settled in '50; incorp. city in '56. Has sewers and incandescent electric lights and steam heating.

History.—Built in '70 by Tyrone Gas and Water-Works Co.

Water Supply.—Sinking Spring run, by gravity from impounding reservoir. Drainage area, 15 sq. m.

Dam and Reservoir.—Cap., about 100,000 galls. Dam of logs, planked on lower side, filled in with cobble on upper; 3 ft. high, 35 ft. long, 114 ft. above town. Embankment, 3 ft. high on north, 2 ft. on south side dam. Water passes through two sets of screens to forebay, thence through head-gate and supply main. Forebay is 4 x 25 ft., x 5 ft. deep.

Supply Main.—C. i., 12-in.; length not given. First main, wood, which after 12 years' service was replaced with c. i.

Distribution.—*Mains*, c. i., 7 miles. *Services*, galv. i., black i. *Taps*, 574. *Meters*, none. *Hydrants*, Morris & Tasker, R. D Wood & Co.'s, 31. *Valves*, principally Ludlow.

Consumption, est., 350,000 gall. *Pressure*, 30 lbs.

Financial.—Cost, $30,000. No debt. Ann. op. exp., $100. Ann. rev.: consumers, withheld, est., $6,000; city, $84. Hydrant rental: city puts in hydrants and pays $2 each for water.

Management.—Prest., C. Gwyer. Secy., A. A. Stevens. Treas., P. Sneeringer. Supt., C. H. Diffenbaugh.

ULYSSES, *Potter Co.* (Pop., est., 600.) In Lewisville borough, on hilly ground. Borough incorp. No sewers or electric lights.

History.—Built in '86 by Lewisville Water Co., under direction of Supt., Perry Brigham.

Water Supply.—Springs, by gravity for domestic use, and pumping for fire protection.

Pumping Machinery.—Dy. cap., not given; 3 x 6-in. pump driven by windmill.

Reservoirs.—Cap., 71,000 galls: domestic, 26,000 galls.; fire, 45,000 galls.

Distribution.—*Mains*, 3-in. c. i., 3½ miles. *Services*, w. i. *Taps*, 60. *Meters*, none. *Hydrants*, Chapman, 7. *Valves*, Chapman.

Consumption, unknown. *Pressure:* Ordinary, 30 lbs. Fire, 70 lbs.

Financial.—Cost, $7,000. Cap. stock, $5,000. Bonded debt, $3,000. Int., 6%. Ann. op. exp., "very light." Ann. rev.: consumers, $500; city, $120. Hydrant rental, $20.

Management.—Prest., E. N. Eaton. Secy., J. Brigham. Treas. and Supt., Perry Brigham.

UNION CITY, *Erie Co.* (Pop., 2,171; est., 3,000.) In agricultural district, engaged in manufacturing. Incorp. No sewers or electric lights.

History.—Built in '85 by Wm. Dunmeyer.

Water Supply.—Creek, pumping to tank.

Pumping Machinery.—Dy. cap., 1,440,000 galls.; Knowles, Earle, two Holly, latter added in '89.

Tank.—Cap., 50,000 galls.

Distribution.—*Mains*, kind not given, ½ mile. *Services*, w. i. *Taps*, 22. *Meters*, none. *Hydrants*, kind not given, 8.

Consumption, 25,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 80 lbs.

Financial.—Cost, $6,949. Debt, $11,486: $2,000 at 6, $9,486 at 5%. (Excess of debt over cost not explained.) Ann. op. exp., withheld, est., $500. Ann. rev.: consumers, withheld, est., $500.

Management.—Owner., Wm. Dunmeyer.

UNIONTOWN, *Fayette Co.* (Pop., 3,265; est., 6,000.) In rolling country on Redstone creek. In agricultural, coke and iron region. Incorp. borough in 1783. Has electric lights.

History.—Built in '83 by Uniontown Water Co. Engr., C. W. Knight, Rome.

Water Supply.—Springs, by gravity from impounding reservoir.

Reservoirs.—Cap., 24,000,000 galls.; Hutchinson, 18,000,000, Bennington, 3,000,000, Cool Spring, 3,000,000.

Distribution.—*Mains*, c. i., 15 miles. *Services*, lead. *Taps*, 600. *Meters*, not given. *Hydrants*, Mathews, 60.

Consumption, not given. *Pressure*, 160 lbs.

Financial.—Cost, withheld, est., $80,000. Debt, $25,000. Int. 6%. Ann. op. exp., withheld, est., $2,000. Ann. rev.: total, withheld, est., $9,000.

Management.—Prest., W. H. Playford. Secy., W. B. McCormick. Treas., M. H. Bowman. Supt., G. H. Seaton.

UPLAND, *Delaware Co.* (Pop., borough, 2,028.) See Chester

UREKA, *(Fisher P. O.) Clarion Co.* (Pop., est., 800.)

History.—Built in '87 by H. G. Fisher, Miller & Co. Contr., R. B. Thomas, Clarion.

Water Supply.—Mahoning river, pumping to tanks.

Pumping Machinery.—Dy. cap., not given; Cameron.

Tanks.—No data.

Distribution.—*Mains*, 6 to 4-in. c. i., 2 miles. *Taps*, 100. *Hydrants*, 5. *Consumption*, about 36,000 galls.

Financial.—Cost, $9,400. Ann. op. exp., $800. Ann. rev.: total, withheld. est., $1,500.

Management.—Not given.

NOTE.—No response to inquiries sent in '89.

WALL and WILMERDING, *Allegheny Co.* (Pop.: Wall, est., 700; Wilmerding, not given.) Near Pittsburgh. Site of new Westinghouse works.

General Description.—Unofficially reported, middle of '89, that Turtle Creek Water Co. was building works. Source not given, but by pumping to 3,000,000-gall. reservoir, 176 x 296 ft. at top, 125 x 245 ft. at bottom, 17 ft. deep, near Port Perry. A 5,000,000-gall. reservoir also proposed. Officially reported that 3,000,000-gall. triple expansion Worthington pumping engine was placed at Port Perry in '89.

WALSTON, *Jefferson Co.* (Pop., est., 2,000.) Mining town, owned by Rochester & Pittsburgh Coal & Iron Co. Not incorp. No sewers or electric lights.

History.—Built in '82-3 to supply their coke ovens and town. Engr., Jno. McLeary, Supt.

Water Supply.—Two artesian wells and Mahoning river, pumping to tanks Connection with river by 6-in. pipe.

Pumping Machinery.—Dy cap., 60,000 galls. Cameron No. 7. *Boiler:* from Erie City Iron Works.

Tank.—Cap., 12,000 galls.

Distribution.—*Mains*, 2-in. w. i., 1 mile. *Taps*, 25. *Meters* and *Hydrants*, none.

Consumption, 2,000 galls. *Pressure*, 75 lbs.

Management.—Prest., Geo. E. Merchant, Rochester, N. Y. Secy., H. K. Southern, N. Y. City. Supt., John McLeary. Treas. and Genl. Mgr., Ja. Haskill.

WARREN, *Warren Co.* (Pop., 2,810; est., 6,000.) On Allegheny river, at mouth of Conewayo creek, on hilly ground in oil region. River, 1,200 ft. above sea-level and rises about 12 ft. at freshets. Settled in 1795; incorp. borough in '32. Has sewers and electric lights.

History.—Built in '81-2 by Warren Water Co. Engr., Geo. O. Cornelius. Contrs., R. D. Wood & Co., Philadelphia; Inman Bros., N. Y. City. Sub-contrs. for masonry, Ohren & Schwartz; for buildings, James Nixon.

Water Supply.—Allegheny and Morrison's rivers, by gravity and pumping to reservoir.

Pumping Machinery.—Cap., 1,500,000 galls.; two Knowles dup., 16-in. steam 20-in. water cylinders, with adjustable stroke of 14 to 20 ins.

Reservoir.—Cap., 1,500,000 galls.; in excavation and embankment, 100 x 200 ft. at water-line, 15 ft. deep.

Distribution.—*Mains*, 14 to 4-in. c. i., 15 miles. *Services*, lead. *Taps*, 400. *Meters*, 15. *Hydrants*, Mathews, 54. *Valves*, Eddy.

Consumption, not given. *Pressure:* Ordinary, 70 lbs. Fire, 135 lbs.

Financial.—Cost, $110,000. Cap. stock, $80,000. Bonded debt, $30,000. Int. 6%. Ann. op. exp., $2,200. Ann. rev.: consumers, withheld, est., $10,000; city, $1,025. Hydrant rental, $20.

Management.—Prest., G. C. Orr. Treas., Wm. Pollock. Supt. and Secy., W. B. Meredith.

WASHINGTON, *Washington Co.* (Pop., 4,292: est., 7,000.) On Chartier's creek, in farming, sheep-raising and bituminous coal region. Town lighted and heated by natural gas. Incorp. No sewers. Has electric lights.

History.—Built in '87-8 by Citizens' Water Co., which is controlled by Kittanning Consolidated Water Cos. of Kittanning; put in operation Dec. 1, '88. Charter perpetual. Des. Engr., R. H. Wilson. Const. Engr., James McCullough, Jr. Contrs., Coon & Co., Washington. Sub-contr. for masonry and buildings, Foegey & Co., Washington.

Water Supply.—Chartier's creek, pumping from filtering wells near impounding to distributing reservoir.

Pumping Machinery.—Dy. cap., 3,000,000 galls; Deane dup.

Reservoirs.—Cap., 16,000,000 galls.; distributing, 3,000,000, impounding, 13,000,000.

Distribution.—*Mains*, 12 to 4-in. c. i., 10 miles. *Services*, not given. *Taps*, 250. *Meters*, none. *Hydrants*, Holyoke, 40.

Consumption, unknown. *Pressure*, 80 to 90 lbs.

Financial.—Cost, $265,000. Cap. stock, $250,000. Mortgage bonds, $75,000. Int., 6%. Ann. op. exp., not determined. Ann. rev.: consumers, not determined, est. for '89, $6,000; city, about $200 in '88. Hydrant rental, $50.

Management.—Prest., Saml. Hazlitt. Secy., G. H. Fox, Kittanning. Treas., Wm. Pollock. Supt., R. H. Wilson.

WATSONTOWN, *Northumberland Co.* (Pop., 1,481; est., 3,000.) On west branch of Susquehanna river. Has manufactories. Incorp. No sewers. Has electric lights.

History.—Built in '87 by Watsontown Water Co. Des. Engr., J. E. Mathews.

Water Supply.—White Deer creek, pumping to reservoirs.

Pumping Machinery.—Dy. cap., 720,000 galls.; two Worthington.

Reservoirs.—Cap., 2,000,000 galls.; four.

Distribution.—*Mains*, kind not given, 5 miles. *Taps*, withheld, est., 250. *Meters*, none. *Hydrants*, kind not given, 34.

Consumption, 300,000 galls. *Pressure*, 70 lbs.

Financial.—Cost, $40,000. Bonded debt, $40,000. Int., 6%. Ann. op. exp., $1,000. Ann. rev.: consumers, $2,500; city, $900. Hydrant rental, $30, with four free.

Management.—Prest., S. B. Morgan. Secy., Wm. F. Shay. Treas. and Supt., Robt. Buck.

WAYNE, *Delaware Co.* (Pop., est., 1,500; summer, 2,500.) Not incorp. Has sewers and electric lights.

History.—Built in '81, and owned by Drexel & Childs, proprietors of Wayne estate. Engr. and Contr., Isaac S. Cassin, Philadelphia.

Water Supply.—Surface well, Ithan creek and Gulf creek, pumping through mains to reservoir. Well dug in '89; 20 ft. in diam., 35 ft. deep, lined with 18 ins. of brick in cem.

Subsiding Reservoir.—Cap,, 450,000 galls.; in excavation, 60 x 180 ft.; inner slopes, 2½ to 1. Influent and effluent pipes controlled by valves.

Pumping Machinery.—Dy. cap., 714,000 galls.; 316,000 Worthington, 367,000 Holly, added in '89, at main station, 71,000 Delameter at secondary. *Boilers:* two 30-H. P., added in '89.

Reservoir.—Cap., 500,000 galls.; depth, 10 ft. Banks of loam, without heart-wall; 12 ft. high, 12 ft. wide on top; slopes, 1½ to 1, inner paved with brick on 15 ins. of puddle; outer, sanded. *Discharge-pipes:* two 8-in. Built in '81. Engr. and Contr., see History. Cost, not given.

Distribution.—*Mains*, 6-in. c. i., 5 miles. *Services*, lead. Pipe and specials from, and pipe laid by, I. S. Cassin. *Taps*, about 120. *Meters*, none. *Hydrants*, 35.

Consumption, 133,054 galls. *Pressure*, 32 lbs.

Financial.—Cost, $40,000. No debt. Ann. op. exp. (in '83), $800. Ann. rev.: withheld, est., $2,500.

Management.—Mgr., Frank Smith.

WAYNESBOROUGH, *Franklin Co.* (Pop., 1,888; est., 4,000.) In agricultural region. Manufactures fruit evaporators, threshing machines and steam engines. Incorp. No sewers or electric lights.

History.—Built in '82-4 by Waynesborough Water Co. Engr., E. P. McGinley, Danville. Contrs., American Const. Co., Philadelphia.

Water Supply.—Mountain springs, by gravity.

Reservoir.—Cap., 1,500,000 galls.; 123 ft. sq., 15 ft. deep.

Distribution.—*Mains*, 12 to 4-in. c. i., 9 miles. *Services*, galv. i. *Taps*, 500. *Meters*, none. *Hydrants*, Mathews, 26. *Valves*, Eddy.

Consumption, 1,000,000 galls. *Pressure:* Ordinary, 70 lbs. Fire, 85 lbs.

Financial.—Cost, $75,000. Bonded debt, $38,000. Int., 6%. Ann. op. exp., $500. Ann. rev.: consumers, $5,000; city, $390. Hydrant rental, $15.

Management.—Prest., Caleb H. Horne. Secy. and Supt., Geo. S. Meyer. Treas., Geo. J. Beecher. Asst. Supt., Jno. R. Hoeflich.

WAYNESBURGH, *Greene Co.* (Pop., 1,208; est., 2,500.) Has electric lights.

History.—Built in '87-8 by Waynesburgh Water Co. Const. Engrs. and Contrs., Jas H. Harlow & Co., Pittsburgh.

Water Supply.—Ten Mile run, pumping to reservoir.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Smith & Vaile. *Boilers:* two steel tubular, 4x12 ft.

Reservoir.—Cap., 1,000,000 galls.

Distribution.—*Mains*, c. i., about 4 miles. *Services*, lead, iron. *Taps*, 25. *Meters*, not given. *Hydrants*, Holyoke, 28. *Valves*, Holyoke.

Consumption, not given. *Pressure*, 125 lbs.

Financial.—Cost, about $75,000. Authorized cap. stock, $50,000. Bonded debt, $12,000. Bonds authorized, $25,000. Int., 6%. Ann. op. exp. and rev. from consumers, none, or small, in '88. Hydrant rental, $50.

Management.—(In '88.) Prest., Wm. Pollock. Treas., J. D. Singley. Supt. and Secy., L. N. Singley.

WEATHERLY, *Carbon Co.* (Pop., 1,977; est., 3,000.) In coal mining district; has railroad repair shops.

History.—Built in '81-2 by Weatherly Water Co., without Engr. Contr., H. L. Foster, Pottsville.

Water Supply.—Penrose creek, and springs, by gravity.

Reservoir.—Cap., 250,000 galls.

Distribution.—(In '87.) *Mains*, c. i., 6 miles. *Services*, lead. *Taps*, 325. *Meters*, none. *Hydrants*, Bailey, said to be 150. *Valves*, B. E. Lehman.

Consumption, 25,000 galls. *Pressure*, 90 lbs.

Financial.—(In '87.) Cost, $25,000. Cap. stock, $12,000. Debt, $3,000. Int. 5%. Ann. op. exp., not given. Ann rev.: consumers, $2,000; city, not given.

Management.—(In '88.) Prest., W. W. Blakeslee. Treas. A. J. Landerburn. Secy., S. G. Eby. Acting Supt., B. F. Clewell.

NOTE.—No reply received to inquiries sent in '89.

WELLSBOROUGH, *Tioga Co.* (Pop., 2,228; est., 3,000.) In mining and agricultural section. Has sewers. No electric lights.

History.—Built in '86 by Wellsborough Water Co. Engr., H. C. Heermans, Corning, N.Y. Floods of May 31, '89, washed out dams and pipes at source of supply

Water Supply.—Springs, by gravity to and from reservoir.

Reservoir.—Cap., about 70,000,000 galls.; 700 x 800 ft.; max. depth, 20 ft.

Distribution.—*Mains*, c. i., 16½ miles, including 11 miles from springs to reservoir. *Services*, galv. i. *Taps*, 241. *Meters*, none. *Hydrants*, Mathews, 43. *Valves*, Eddy.

Consumption, not given. *Pressure*, 86 lbs.

Financial.—Cost, $96,000. Cap. stock, $75,000. Bonded debt, $20,000. Int., 6%. Ann. op. exp., $1,200. Ann. rev.: consumers, $2,800; city, $2,150. Hydrant rental, $50.

Management.—Prest., Wm. Bacher. Secy., J. Harrison. Supt., W. C. Kress.

WEST BETHLEHEM, *Southampton Co.* (Pop. est., 3,000). See So. Bethlehem.

WEST CHESTER, *Chester Co.* (Pop., 7,046; est., 11,000.) On elevated ridge between Chester and Brandywine creeks, about two miles from each; 16 miles from Wilmington, Del., 21 from Philadelphia. Settled in 1780; incorp. borough in 1789. Has sewers and electric lights.

History.—Built in '45-6 by borough. New works built in '81. Engr. and Contr., Isaac S. Cassin, Philadelphia.

Water Supply.—Chester creek, fed by springs, pumping to reservoir. First supply was from Bath springs, pumped through 800 ft. of 8 and 6-in. c. i. pipe to reservoir. In '54 source was changed to Chester creek, 2 miles from town. There was a settling basin 125 ft. sq. at pumping station, used only when stream was muddy.

Pumping Machinery.—Dy. cap., 1,250,000 galls.; 750,000 Worthington dup., and old 500,000-gall. pump.

Force-Mains.—In '51 a 6 in. force-main was laid, 10,560 ft. long, to connect new supply and reservoir. In '81 additional force-main, 12-in., was laid to connect with new reservoir.

Reservoir.—Cap., 2,500,000 galls.; 150 x 175 ft., 14 ft. deep. 91 ft. above pump. 35 to 100 ft. above town.

Distribution.—*Mains.* c. i., 14½ miles. *Services.* c. i. *Taps,* 1,550. *Meters.* 3. *Hydrants,* Cassin, 144. *Valves,* Cassin.

Consumption, 400,000 galls. *Pressure:* Ordinary, 48 lbs. Fire, 70 lbs

Financial.—Cost, $56,030. Debt, including other borough debts, $130,000. Sinking fund, $2,668. Int., 4%. Ann. op. exp., $3,123. Ann. rev.: total, $16,300.

Management.—Com. of three. Chn., Chas. B. Lear. Supt., E. P. Mercer.

WEST PITTSTON, *Luzerne Co.* (Pop., 2,544.) See Pittston.

WICONISCO, *Dauphin Co.* (Pop., est., 1,800.) See Lykens.

WILKES-BARRE, *Luzerne Co.* (Pop., 33,339; est., 40,000.) On east side of north branch of Susquehanna river, in center of Wyoming valley anthracite coal fields. Has various manufactories. Settled in 1770; incorp. borough in '06; city in '71. Has Waring system of sewers and electric lights.

CRYSTAL SPRING WATER CO.

Supplies part of the city and also Ashley, but *gives no information.* T. H. Phillips is connected with Co.

WILKES-BARRE WATER CO.

History.—Built in '57-9. Engr., Dr. Chas. F. Ingram, Wilkes-Barre. Co. did all work except laying pipe.

Water Supply.—Laurel run, by gravity, and by pumping to reservoir. First supply, by gravity from impounding reservoir on stream at a point 2½ miles from the city and 150 ft. above general level. Larger reservoir has been built since and pump added.

Reservoirs.—Combined cap., 48,000,000 galls.; 8,000,000 and 40,000,000 galls.

Dam.—For first reservoir: stone, 8 ft. thick at bottom, 5 at top, 20 ft. high; built on a curve.

Pumping Machinery.—Dy. cap., 4,000,000 galls.; Worthington comp., cond.

Distribution.—*Mains,* c. i., 45 miles. *Services,* w. i. *Taps,* 4,100. *Meters,* 4. *Hydrants,* Ayers, Mathews, 101. *Valves,* Eddy, Ludlow.

Consumption, 5,000,000 galls. *Pressure:* Ordinary, 37½ lbs. Fire, 45 lbs.

Financial.—Cost (to '81), $220,000. Cap. stock (in '81), $22,000. No debt. Ann. op. exp., withheld, est., $5,000. Ann. rev.: consumers (in '81), $29,415; city, $1,250. Hydrant rental, $12.50.

Management.—Prest., B. G. Carpenter. Secy. and Treas., B. M. Espy. Supt., Roger McGarry.

WILKINSBURGH, *Allegheny Co.* (Pop., est., 3,500; charter rights cover est. pop. of 10,000.) Is 11 miles from Pittsburgh. Engaged in manufacturing. No sewers. Has electric lights

History.—Built in '88-9 by Pennsylvania Water Co.; put in operation Oct., '89. Built to supply territory between easterly line of Pittsburgh and Braddock, including that part of Braddock outside borough limits. Engrs. and Contrs., Jas. H. Harlow & Co., Pittsburgh.

Water Supply.—Allegheny river, pumping to reservoir.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two 1,000,000 Deane comp., cond. *Boilers:* from R. Monroe & Son, Pittsburgh.

Reservoir.—Cap., about 7,000,000 galls.

Distribution.—*Mains,* c. i., 17 miles. *Services,* lead. Pipe and specials from Lake Shore Foundry Co., Cleveland, O. *Taps,* 200. *Meters,* 10. *Hydrants,* Bourbon, 20. *Valves,* Rensseler.

Pressure: Ordinary, 90 lbs. Fire 140 lbs.

Financial.—Cost, est., $300,000. Cap. stock, $200,000. Bonded debt, $100,000. Int., 6%. Hydrant rental, $50; 10-years contract.

Management.—Prest., Jno. D. Cherry. Secy., Edw. J. Harlow. Treas., Saml. Douht. Supt., W. A. Alexander. Latest report, Dec. 26. '89.

WILLIAMSPORT, *Lycoming Co.* (Pop., 18,934; est., 28,000.) On west branch of Susquehanna river, at foot of range of hills. Lycoming creek flows through city. Has steam saw mills, furniture factories, iron foundries and machine shops. Founded about 1795; incorp. city in '61. Has sewers and electric lights.

History.—Owned and operated by Williamsport Water Co., and Citizens' Water & Gas Co. The first Co. was incorp. in '53, when pop. was about 2,500, and built its works in '56-9. In '65 Lycoming Gas & Water Co., now Citizens' Gas & Water Co., was incorp. Both Cos. now under one management; charters are perpetual.

Water Supply.—Two mountain streams, by gravity. Supplemented in fall by direct pumping, surplus passing to reservoir. First Co. took its supply from Hagerman's run and the second from Mosquito creek. Both streams are south of river, each drains about 25 sq. m.

Dam and Reservoirs.—One 729x650 ft., with water 17 ft. deep at breast of dam, and one 70x100 ft. by 10 ft. deep throughout.

Pumping Machinery.—Dy. cap., 4,500,000 galls.; a Knowles comp., cond.; also small Knowles for emergency. *Boilers:* 80-H. P. steel tubular for large, 60-H. P. for small pump.

Distribution.—*Mains*, c. i., 53 miles. *Services*, galv. i., with brass corporation cocks. *Taps*, in '87, 3,600. *Meters*, L. *Hydrants*, 174; put in and owned by city; Mathews recommended after trial of several kinds. *Valves*, Eddy, Ludlow, Galvin Chapman, now using latter exclusively.

Consumption, est., 2,000,000 galls. *Pressure:* Ordinary, 42 lbs. Fire, 75 lbs. at pump.

Financial.—Cost, in '87, $500,000. Debt (in '87), $225,000. Int., 5%. Ann. op. exp., withheld, est., $6,500. Ann. rev.: consumers (in '80), $37,616; city, $1,740. Hydrant rental, city owning hydrants, $10.

Management.—Officers of two Cos. same, except Prests.: Williamsport Water Co., Jas. M. Gamble; Citizens' Water & Gas Co., Jno. White. Secy., Treas. and Supt., W. H. Bloom.

WILMERDING, *Allegheny Co.* See Wall.

WYNCOTE, *Montgomery Co.* See Jenkintown.

YORK, *York Co.* (Pop. 13,940; est., 20,500.) On both sides of Codorous creek, in thickly populated agricultural district. Manufactures iron and steel, railway cars and agricultural implements. Settled in 1720. No sewers. Has electric lights.

History.—Built in '16 by York Water Co. All labor now done by Co.

Water Supply.—Springs and surface water, pumping to reservoirs

Pumping Machinery.—Dy. cap., 1,100,000 galls. First pump and boiler erected in '50, by Birkinbine, Martin & Trotter, patterned after Graff's, at Fairmount Station, Philadelphia. In '73 pump duplicated by Banner, Fray & Knotz. In '85 Deane water-power pump added. *Boilers:* 50-H. P. return tubular: one erected in '73, one in '83.

Reservoir.—Cap., 11,000,000 galls.; area, 1¼ acres; 107½ ft. above pumps, 15 ft. above highest part of town. Banks of brick clay. Built in '50 by Co. Engr., —— Fulton.

Distribution.—*Mains*, c. i., 22 miles; to '40 all mains of wood; first c. i. pipe made at Margretta Furnace, '40-1, later by S. Bechtal & Co., York, Small & Smyser, R. D. Wood & Co., Philadelphia. *Services*, lead. *Taps*, 4,000. *Meters*, Crown, 2. *Hydrants*, Ludlow, Birkinbine, 79. *Valves*, Ludlow. *Close of* '60: Taps, 2,100. Hydrants, 40. *Do.*, '70: Taps, 2,500. Hydrants, 52. *Do.*, '80: Taps, 3,030. Hydrants, 63. *Consumption*, 600,000 galls. *Pressure*, 12 to 45 lbs.

Financial.—Cost, $200,000. Cap. stock, $100,000; originally, $10,500. No debt. Ann. op. exp., withheld, est., $3,000. Ann. rev.: consumers, $39,000; city, none Hydrant rental, free. Cost, close of '80, $165.000

Management.—Prest., J. Carl. Secy., Smyser Williams. Treas., W. H. Griffith. Supt., Jacob L. Kuehn.

Water-Works Projected with Fair Prospects of Construction.

ANNVILLE, *Lebanon Co.* (Pop., est., 1,500.) Engaged in manufacturing and farming.

Proposed Works.—Two charters or franchises have been granted and two Annville Water Cos. organized. One Co. has for Prest., H. H. Kreider; Secy., C. Dean. Oct. 1, '89, this Co. was negotiating for water rights. Other Co. has for Prest., S. L. Brightville; Secy., H. Zimmerman. Feb. 27, '90, second Co. had had preliminary surveys made by Fehr & Butler, Easton, but had not decided as to source. Est. cost, $15,000; to be raised by stock subscriptions: Nov. 27, '89, about half of stock had been sold.

BERWYN, *Chester Co.* See Paoli.

CHARTIERS, *Allegheny Co.* See Mansfield.

CLIFTON HEIGHTS, *Delaware Co.* (Pop., est., 2,000.) Is 7 miles from Philadelphia.

Proposed Works.—Clifton Heights Water Co. to build. No contracts let Mar. 17,'90 Secy. W. J. Crawford. Unofficially reported, Feb., '90, that S. P. Bartleson had just been elected Prest., I. F. Jones, Secy.; that cap. stock had been increased, and that reservoir and pumping station was to be erected to supply Lansdowne, Darby, Fernwood, Sharon Hill and Burmont.

CURWENSVILLE, *Clearfield Co.* (Pop., 706; est., 1,500.) On Susquehanna river. Has tanneries, woolen mills and foundries.

Present Supply.—Three or more private pipe lines from springs, and 4 small reservoirs for fire protection.

Proposed Works.—Co. to put in complete works May to Aug., '90. Supply, springs, by gravity. Contrs., Shafer & Thompson. Address F. I. Thompson. Date of report, Jan. 9, '90.

EAST STROUDSBURGH, *Monroe Co.* (Pop., 1,102; est., 1,800.) One mile from Stroudsburgh. Has manufactories.

Proposed Works.—Borough to build. Secy. Council, A. R. Brittain. Chf. Burgess, L. H. Burnett. Report, Oct. 5, '89. Unofficially reported in Dec. that town would issue $38,500 of 5% bonds.

ELIZABETHVILLE, *Dauphin Co.* (Pop., est., 1,200.)

Proposed Works.—Elizabethville Water Co. to complete gravity works middle of '90. Cost $8,000; $6,000 secured. Prest., H. H. Weaver Secy., C. B. Stroup. Date report, Jan. 6, '90.

HOMESTEAD, *Allegheny Co.* (Pop., est., 8,000.) On Monongahela river, 8 miles from Pittsburgh. Manufactures glass, steel and fire brick.

Proposed Works.—Feb. 18, '90, town voted $70,000 of bonds for works. Supply, Monongahela river. No definite plans. Probably works will not be built for two years. From M. P. Schooly, Clerk; date, Feb. 28, '90.

KUTZTOWN, *Berks Co.* (Pop., 1,198.) Is 17 miles from Reading. Has iron furnace, foundry and carriage factory.

Proposed Works.—Kutztown Water Co. incorp. about middle of '89. Chas. Miller, J. S. Trexler among incorporators.

MANSFIELD, *Tioga Co.* (Pop., 1,611; est., 2,500.) In farming section.

Proposed Works.—Unofficially stated that Monongahela Water Co. will build in '90 to supply Mansfield and Chartiers. Supply, Ohio river, pumping to reservoir Est. cost, $250,000. Jan. 6, '90, resident reported that nothing definite had been done

PAOLI and BERWYN, *Chester Co.* (Pop. not given.)

Proposed Works.—Doyleford Water Co., chartered in '89. Prest., Wm. Latta. Vice-Prest., Wm. Hammersley. Secy., W. M. Graham.

PINE GROVE, *Schuylkill Co.* (Pop., 957; est., 1,500.) In coal region.

Proposed Works.—Borough to build in '90. Supply, Black creek, pumping to stand-pipe. Est. cost, $25,000 to $30,000. Nothing done last of Feb., '90. Chn. Water Board, A. T. Felty.

ROCHESTER, *Beaver Co.* (Pop., 2,552; est., $5,000.) At junction of Beaver with Ohio rivers. Manufactures carriages, coffins and glassware.

Proposed Works.—Rochester Water Co. hope to build in '90; construction in '89 postponed owing to failure of making hydrant contract with borough. Engr. and Contr., Ellis Morrison, New Castle. For further data see MANUAL for '89, p. 235. Prest., Jno. M. Buchanan. Secy., A. J. McCoy.

SALTSBURGH, *Indiana Co.* (Pop., 855; est., 860.) Engaged in coal mining and glassmaking.

Proposed Works.—Dec. 6, '89, Water Com. reported favorably upon town building works after plans by Engrs., Wilson & Smith, Saltsburgh. Supply, Kiskiminetas river, 500,000-gall. pumps lifting to 750,000-gall. reservoir. Mains, 3½ miles.

SCOTTDALE, *Westmoreland Co.* (Pop., 1,275; est., 3,000.)

Proposed Works.—June 20, '89, Citizens' Water Co. had secured charter, made preliminary surveys and secured subscriptions for $10,000 of stock. Supply, mountain stream, by gravity. Est. cost, $60,000. Secy. Henry Taylor. Treas., Nath. Miles.

Unofficially reported, Feb., '90, that a Co. had offered to build works, est. to cost $100,000, if town would pay $2,200 hydrant rental yearly.

Water-Works Projects Reported in '89–'90, but Now Indefinite.

Cheltenham, Montgomery Co. *Crafton*, Allegheny Co. *Lawrenceville*, Tioga Co. *Montrose*, Susquehanna Co. *Myerstown*, Lebanon Co.

DELAWARE.

Water-Works Completed or in Process of Construction.

DOVER, *Kent Co,* (Pop., 2,811; est., 4,500.) On Jones creek, 5 miles from Delaware bay, on level ground. Has large glass factory; in peach-growing and agricultural district. Settled in 1683. Incorp. Partially sewered. No electric lights.

History.—Built in '82 by town. Engr., Isaac S. Cassin, Philadelphia, Pa. Contrs., Holly Mfg. Co., Lockport, N. Y.

Water Supply.—Wells, by direct pumping. One well 15 ft. in diam., 24 ft. deep; other, 20 ft. in diam., 28 ft. deep. First well sunk for 17 ft. through water-bearing strata.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; two Gaskill dup. low-pressure. *Boilers:* two 60-H. P. horizontal tubular.

Distribution.—*Mains*, c. i., 3¾ miles; extensions upon agreement of consumers to take water, rental for which will be 10% of cost of extension. *Services*, galv. i., lead. *Taps*, 237. *Meters*, 1. *Hydrants*, Holly, 29.

Consumption, 59,102 galls. *Pressure:* Ordinary, 40 lbs. Fire, 85 lbs.

Financial.—Cost, $23,000. Bonded debt, $21,500: $1,500 at 6, $20,000 at 4%. Ann. op. exp., about $2,400. Ann. rev.: consumers, $3,168.

Management.—Water Com. of three. Chf. Engr., T. F. Cook.

MIDDLETOWN, *New Castle Co.* (Pop., 1,280; est., 2,000.) Incorp. No sewers. Has electric lights.

History.—Built by town, date not given.

Water Supply.—Not given.

Pumping Machinery.—Dy. cap., 500,000 galls.; Worthington.

Distribution.—*Mains*, kind not given, 2 miles. *Services*, not given. *Taps*, 76. *Hydrants*, kind not given, 8.

Consumption, 20,000 galls. *Pressure*, 85 lbs.

Financial.—Cost, $17,000. Debt, $17,000. Int., 5%. Ann. op exp., $800. Ann. rev.: consumers, $500.

Management.—Prest., Thos. E. Hurn. Secy., Walter Leatherberry. Treas., Geo. D. Kelley. Supt., J. M. Leatherberry.

NEWARK, *New Castle Co.* (Pop. of township, 1,143; est., 2,000.) Has manufactories. Incorp. in '52. No sewers or electric lights.

History.—Built in '88-9 by town; put in operation in Feb. Des. Engr., Isaac S. Cassin. Const. Engr., Isaac S. Cassin, Jr. Both of Philadelphia, Pa. Contr. for labor, Jos. Hyde, Wilmington.

Water Supply.—Well, pumping to stand-pipe and direct. Well is 25 ft. in diam., 35 ft. deep.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; two 500,000 Gaskill comp., dup. *Boilers:* two, 4½ x 12 ft.; Holly.

Stand-Pipe.—Cap., 186,000 galls.; 25 x 50 ft.; on elevation of 50 ft. Top 140 ft. above lower parts of the town. About one mile from pump. From Basshor & Co., Baltimore, Md.

Distribution.—*Mains*, 10 to 6-in. c. i., 3 miles. *Services*, galv. i., w. i., lead. Pipe and specials from McNeal Pipe & Foundry Co., Burlington, N. J. *Taps*, 50. *Meters*, none. *Hydrants*, Cassin, 35. *Valves*, kind, do.

Consumption, 50,000 galls. *Pressure:* Ordinary, 56 lbs. Fire, 125 lbs.

Financial.—Cost, $37,000. Bonded debt, $37,000. Int., 5%. Ann. op. exp., $1,000. Ann. rev.: consumers, $1,200; city, $700. Hydrant rental, $20.

Management.—Town Council. Secy. and Treas., G. W. Williams. Supt., Jas. Hayes.

NEW CASTLE, *New Castle Co.* (Pop., 3,700; est., 4,500.) On flat, sandy ground on Delaware river at head of Delaware bay, 5 miles from Wilmington. Has iron and pipe works, cotton, woolen, carpet and rolling mills. Settled in 1600; incorp. city in '73.

History.—Built in '70 by New Castle Water-Works Co. Engr., Isaac S. Cassin, Philadelphia, Pa. Contrs., Holly Mfg. Co., N. Y. City.

Water Supply.—None Such creek, fed by springs, pumping to reservoir.

Pumping Machinery.—Dy. cap., 2,500,000 galls.; 750,000 Blake, 1,750,000 Davidson.

Reservoir.—Cap., 1,250,000 galls., 92 ft. above city.

Distribution.—*Mains*, c. i., 8½ miles. *Services*, iron. *Taps*, 507. *Meters*, none. *Hydrants*, 40; from Morris, Tasker & Co., Philadelphia.

Consumption, 450,000 galls. *Pressure*, 26 lbs.

Financial.—Cost, $112,000. Cap. stock, $51,000. Bonded debt, $54,000. Int., 5%. Ann. op. exp. $4,500. Ann. rev.: consumers, $8,000.

Management.—Prest., Jas. G. Shaw. Sec. and Treas., Wm. H. Clark. Engr-in-Charge, I. C. Slaw.

SMYRNA, *Kent Co.* (Pop., 2,423; est., 3,000.) In Duck Creek hundred. Engaged in manufacturing and peach trade. Incorp. No sewers or electric lights.

History.—Built in '86 by town. Engr., Isaac S. Cassin, Philadelphia, Pa. Contrs., A. H. Coon & Co.

Water Supply.—Surface well, pumping to stand-pipe and direct.

Pumping Machinery.—Dy. cap., 845,000 galls.; two Gordon & Maxwell comp., dup.

Stand-Pipe.—Cap., 37,600 galls.; 8x100 ft.

Distribution.—*Mains*, c. i., 3½ miles. *Services*, galv. i. *Taps*, 288. *Meters*, none. *Hydrants*, kind not given, 35.

Consumption, 28,000 galls. *Pressure:* Ordinary, 52 lbs. Fire, 100 lbs.

Financial.—Cost, $24,000. Debt, $24,000. Int., 4%. Sinking fund, for '90, $1,000. Ann. op. exp., $1,100. Ann. rev.: consumers, $2,081; city, $612. Hydrant rental, $18.

Management.—Town Comrs. Secy., J. B. Cooper. Supt., A. Taylor.

WILMINGTON, *New Castle Co.* (Pop., 42,478.) At confluence of Brandywine and Christiana creeks, at head of navigation, 2 miles from Delaware river. On elevated ground between two creeks, rising from them on three sides, and reaching an elevation of 243 ft. at north. Builds wooden and iron steamboats and cars, manufactures cotton and woolen goods, morocco and powder. First Swedish colony in America landed here in 1638. Town founded in 1732; incorp. borough in 1740, city in '32. Partially sewered. Has electric lights.

History.—First supplied in '04 by Wilmington Spring Water Co., whose works were bought by the borough in '10, and extended from time to time since, the most important changes being in '64 and '74.

First supply was from a "fountain" in High, now Fourth street, which was fed by springs, and furnished water to part of town lying below. Price paid in '10 by borough for these works was $10,000, and water was conveyed from springs through wooden pipes along principal streets to cisterns, from which it was drawn by pumps. Supply gradually decreased from 35 galls. a minute in '10 to 14, in '20 and in '25 a 3-in. iron pipe having been laid to a reservoir between the present 10th and 11th streets, a contract was made for iron pipe to conduct water from this reservoir down Market to 4th street, and for fire plugs along the line.

In '27 a water-power was purchased on Brandywine creek, and an overshot wheel put in, 14½ ft. in diam. by 45¼ ft. wide, which worked a double-acting 8x72-in. force pump. Water was lifted to two reservoirs, 99 ft. above, through 2,120 ft. of 8-in. pipe. Reservoirs abandoned in '79. In '32 a similar pump was added. In '79 wheel went to pieces, and pumping machinery was replaced in '81 by a Jonval turbine, working two 1,600,000-gall. pumps. Water-power pumps were abandoned in '87 as worthless. In '55 a 3,000,000-gall. Cornish bull engine was erected for use in case of emergency. It was not used after '77, and has been removed. In '64 a high service supply was introduced and since then the works have been extended to the system described below, which was completed in '87, large reservoir being built from 74-8. Engr. of reservoirs, Isaac S. Cassin, Philadelphia, Pa. Water department was organized in '27.

Water Supply.—Brandywine creek, pumping to low service reservoir, and repumping to high service reservoir. Creek falls 120 ft. in 4 miles above city.

Pumping Machinery.—*Main works:* dy. cap., 17,000,000 galls.; 10,000,000 comp., cond. Corliss, 5,000,000 comp., dup. Worthington; latter placed in '72, the former in '87. In '89 turbine wheel and pumps placed in '87 (see History) were replaced by a breast wheel 22 ft. in diam., 14 ft. long, driving two 14 x 18 dup. pumps Des. Engr., A. Feldpauche, Philadelphia, Pa. Contrs., Robt. Wetherill & Co., Chester, Pa. *High service:* dy. cap., 3,500,000 galls.; 2,000,000 Knowles, placed in '80, 1,500,000 Worthington.

Reservoirs.—Cap., about 41,600,000 galls. *Low service:* cap., 40,000,000 galls. Originally est. to cost $86,000, for a basin 18 ft. deep, holding 28,000,000 galls. It was begun in '74, by day labor, and in Nov., '76, over $129,000 had been expended, and it was est. that $90,000 was required to finish it. Trouble arose from spring water passing through bank into reservoir, the drain intending to carry it off becoming stopped, and water passing along the inlet and outlet pipes laid through banks. Drains were of 2, 3 and 4-in pipe, some with lead and some with open joints, and the inlet and outlet pipes had not been properly laid.

In '77 special water commission was created by Legislature to complete reservoir. Adjoining land was walled up to divert surface water from banks, bottom and sides were puddled with 2 ft. of clay, and slopes lined with two courses of brick in cem. Bottom puddle was covered with gravel rolled in, then paved with bricks laid flat in sand, and collars of masonry were placed around the inlet and outlet pipes. The 11,000,000-gall. basin was finished in Dec. '77, and the other in Oct. '78. As stated above, the present cap. of reservoir is 40,000,000 galls. Water is pumped to north basin, and passes over the division wall to south. In Nov., '78, just after new basin was filled, an increase was noticed in the flow of the under-drains, and a small hole discovered in the bottom of north basin. It was stopped up and no further trouble was had until Mar., '80, when slope pavement on east side of south basin partially slid down for about 100 ft. in length. It was repaired by first building at the foot of the slope a brick wall 33 ins. wide at top and 39 at bottom, and then repuddling and repaving the break. North and west slopes were strengthened by a similar wall at their base.

High service: cap., 1,600,000 galls.; 210 ft. above creek, about 100 ft. above pumping station supplying it; in excavation and embankment, inner slopes lined with clay puddle and paved with brick in cem.

Distibution.—*Mains*, c. i., 71.34 miles. *Services*, w. i., lead. *Taps*, 11,205. *Meters*, 10. *Hydrants*, generally Chapman, 627. *Valves*, kind, do.

Consumption, 5,814,105 galls. *Pressure*, 15 to 50 lbs.

Financial.—Cost, $700,000. Bonded debt, $622,500: $352,500 at 6, $150,000 at 5, $60,000 at 4½, $60,000 at 3½%. Ann. op. exp., $52,000. Ann. rev.: consumers, $118,308; city, none. Rev., '62, $19,693; '70, $34,306; '80, $64,482.

Management.—Three Comrs. Prest., Wm. T. Porter. Secy., John S. Grohe. Chf. Engr., Jos. A. Bond.

MARYLAND.

Water-Works Completed or in Process of Construction.

ANNAPOLIS, *Ann Arundel Co.* (Pop., 6,642: est., 8,000.) On Severn river, two miles from Chesapeake bay and 20 from Baltimore, in fruit-growing country. Engaged in oyster trade; has glass factory. Settled in 1620; incorp. city about 1720. Has sewers and electric lights.

History.—Built in '65-6 by Annapolis Water Co. Engr., Wm. R. Hutton; for later work, Robt K. Martin, Baltimore.

Water Supply.—Springs and surface water, pumping from impounding to distributing reservoir. Water from several springs and small streams is collected in one stream.

Dam and Reservoirs.—Cap., 8,250,000 galls. *Impounding:* cap., 6,000,000 galls. Dam not described. *Distributing:* cap., 2,250,000 galls.; has puddled clay banks paved with granite.

Filter.—Beneath distributing reservoir, consisting of brick-lined trench covered with wooden slats ½ in. apart, upon which is a layer of coarse gravel, then fine gravel, then 1 ft. of sand.

Supply Main.—A 10-in. main connects with the filter trench, and conveys water 4 miles to town; originally w. i. and cem., which frequently broke, and was replaced with c. i. in '79.

Pumping Machinery.—Dy. cap., not given. First pump placed in '66, 10-in. 500,000 galls. Second pump placed in '81, 12-in. There is a 500,000 Worthington.

Distribution.—*Mains*, c. i., 9½ miles. *Services*, galv. i. *Taps*, 1,100. *Meters*, 6. *Hydrants*, kind not given, 46.

Consumption, not given. *Pressure*, 38 lbs.

Financial.—Cost, $65,000. Cap. stock, $51,450. Bonded debt, $12,000. Int., 6%. Ann. op. exp., $8,910. Ann. rev.: consumers, $17,151; city, $947. Hydrant rental, $75.

Management.—Prest. and Supt., Wm. H. Gorman. Secy. and Treas., J. Harwood Iglehart.

BALTIMORE, *City of Baltimore Co.* (Pop., 332,313; est., 400,000.) At the head of navigation and tide water on Patapsco river, 14 miles from Chesapeake bay, and 200 miles from ocean. Area, about 16 sq. m. Topography irregular, the city being divided by a stream called Jones' falls, east of which ground rises from 13 to 262 ft., and on west, from 4 to 233 ft. above tide level. There are 762 acres at elevations ranging from 171 to 233 ft. Engaged in foreign and domestic commerce, and manufacturing; has large oyster, tobacco, fruit and vegetable trade. Founded in 1730. Has sewers and electric lights.

History.—First supplied in May, '07, by private company. In '54 the city bought works and from '57-62 enlarged them. In '80 Gunpowder river supply was introduced.

In '04, when pop. was about 30,000, an association was formed for purpose of "introducing a copious supply of wholesome water into the city of Baltimore." The water privileges of Jones' falls, immediately above and below present Eager street bridge, were bought, and plans prepared by Jno. Davis, Philadelphia, Pa.

In June, '05, a contract was made for 2½ to 6-in. c. i. pipe, and in Feb., '06, Common Council authorized Co. to lay pipe in streets. In May, '07, pumps located at corner of Centre and Calvert streets supplied city by pumping to reservoirs at various heights above tide-level. In '08 the Legislature granted company a suitable charter and in '11 its income was $9,000.

In '33 Salisbury Mill was bought, and new reservoir and pump-house built. There were then 2,164 takers, and yearly income of $24,300. In '35 about 18 miles of pipe had been laid, one fourth of old, one-half of new pattern c. i., rest of wood. Some of old iron pipe was dug up in '64. It was 3 ins. in diam., in sections 5 ft. long, very heavy, with conical joints. It was in perfect condition, the sand outside having united with the iron by oxidation, thus preventing further corrosion. Inside was worn smooth, and had a slight coating of earthy matter.

From '35 to '52 additional privileges were bought on Jones' falls, new pumps and reservoirs added, and the distribution system extended. In '52 the Co.'s revenue was $80,000.

In '54, city bought works, privileges and real estate of the Co. for $1,350,000. There were at the time two small pools on Jones' falls from which water was conducted by gravity through iron mains to a receiving reservoir on bank of stream below Charles St. bridge, and distributed from here to that part of city not more than 60 ft. above mean tide.

The district not exceeding 136 ft. above mean tide was supplied from a reservoir at Charles and Chase streets, to which water was pumped. Cap. of reservoirs and pools on stream was 35,000,000 galls., and water was frequently quite turbid. When the city bought the works 69 miles of pipe had been laid.

In '57-62 city built new works on Jones' falls. Des. and Consult. Engr., Jas. Slade. Chf. Engr., Chas. P. Manning. In '72 a plan for an additional supply was submitted by R. K. Martin, present Chf. Engr., approved by Chas. P. Manning, then Consult. Engr., and finally adopted. Pending construction of permanent works for additional supply from Gunpowder river, temporary supply was obtained from the same source.

Jones' Falls System, Temporary Gunpowder Supply, and the Gunpowder River System are described separately below. Data under Distribution, Financial and Management is common to both systems, and is given in its usual place.

JONES' FALLS SYSTEM.

General Description.—Dam across Jones' falls forms reservoir called Lake Roland, from which conduit conveys water to Hampden reservoir, which supplies the districts between 112 and 188 ft. above tide-level. Pipe lines lead from Hampden to Mt. Royal reservoir, which supplies lowest part of city. Reservoir called Druid lake, built for additional storage, lies between Hampden and Mt. Royal reservoirs, and water is pumped from this to a high service reservoir in Druid Hill park.

Dam and Roland Lake.—Cap., 400,000,000 galls.; area, 116 acres; surface flooded was first excavated to a depth of at least 10 ft. below overfall of dam, 225 ft. above tide.

In freshets water carries much dirt, which is deposited in lake. In '72 large amount of sediment was removed, and again by dredging in '76-7.

Dam of rubble masonry, faced with cut stone, backed with clay, founded on rock; vertical back, curved face; 320 ft. long, 40 ft. high, 60 ft. thick at foundation. *Spillway*: in dam, 120 ft. long. Cost, $152,000.

Conduit.—Lake Roland to Hampden reservoir. Brick, elliptical, bottom being a semicircle, 2½-ft. radius; top, semi-ellipse, 3.83 ft. high; inside area, 24.75 sq. ft. for 3.62 miles. On embankments rests on wall of rubble masonry.

Hampden Reservoir.—Cap., est., 30,000,000 galls; semicircular; 500-ft. radius; area, 8 acres; 217 ft. above tide. In excavation and embankment, inner slopes covered with 3 ft. of puddle, 2 ft. of gravel, 18-in. stone pavement. Supplies levels between 112 and 188 ft. above tide. Built in connection with new works, '57-62.

Two lines 30-in. c. i. pipe are laid from Hampden to Mt. Royal reservoir, 7,100 ft., passing under Jones' falls in a trench cut from 3 to 5 ft. in rock.

Dam and Druid Lake.—Cap., 463,000,000 galls. Built from '64-71 to increase storage and to give a large supply of clear water for use when stream becomes muddy. Formed by building dam, described below, across a natural valley in Druid Hill park. Part of natural bottom was irregular, and an area about 300 x 900 ft. was filled with from 3 to 25 ft. of dirt, flooded as it was thrown in.

Embankments faced with riprap of large stones, arranged with some care, extending from 2 ft. above to 10 ft. below high-water level. Upper 5 ft. of slope covered with clean gravel from 1 ft. to 3 ins. in depth. Greatest depth of water is at the dam, 65 ft.; some other parts have a depth of 63 ft. and upper end, 20 ft.

Dam of earth with heart-wall; length, not given, 119 ft. high in middle. *Heart-wall:* puddle, 36 ft. at bottom, carried down 12 ft. below natural surface, founded on rock with a core of rubble masonry in cement, 5 ft. high, 2 to 4 ft. wide.

Influent and effluent pipes: beneath dam there were first laid 7 lines of c. i. pipe. These were carried on masonry piers through puddle wall, and simply enclosed in embankment rest of way. Within two years they all broke, and those with less than 44 ft. of earth above them were removed; others were capped and left in place.

Later, 5 lines of 30-in. pipe were laid through dam, in rock-trench on 9 ins. of rubble masonry placed on 9 ins. of concrete, and enclosed in rubble masonry. Whole wall was 25 ft. wide at the bottom, 23 ft at top, and 5½ ft. high, with collars of masonry carried around pipes into rock and earth cuts. There is also a wall on each side of top of masonry, from collar to collar, 1x1½ ft. Sides and top are plastered, making smooth surface. Clay puddle covers the whole for 5 ft.

Three of these pipes are used for distributing water to city. One connects with low service main from Hampden reservoir, discharges 900 ft. up the lake, and can be used to drain the lake. Fifth pipe connects with high service main from Hampden reservoir, discharges 2,300 ft. up lake, and can be used as a siphon to empty lower 24 ft. of lake. In '72 an additional inlet pipe was laid.

Mount Royal Reservoir.—Circular, 550 ft. in diam., having water surface of 5 acres, at 150 ft. above tide. Screen-well in center, and one of the mains from Hampden reservoir extends through its roof, where its contents may be discharged as a fountain under 60 ft. head. Supplies levels less than 112 ft. above tide-level.

Pumping Machinery.—Cap., 6,000,000 galls.; Worthington, located at Druid lake, used to fill Druid Park high service reservoir.

Druid Park High Service Reservoir. Cap., est., 15,000,000 galls.; 501 ft. in diam., 20 ft. deep, 600 ft. from Druid lake, 350 ft. above tide; in earthwork, puddled 4 ft. on inner slopes, then covered with 1 ft. of gravel. When filled north embankment leaked, and after pumps stopped water fell 12 ft., but with alternate raising and lowering leakage through the banks was greatly lessened.

Water first admitted June 8, '74. From the force-main leading to this reservoir a branch extends to Druid lake, and then turns upwards, making a fountain which may be supplied from high service reservoir or by direct pumping.

GUNPOWDER TEMPORARY SUPPLY.

Introduced in '71 for use while building permanent works. Water was pumped from Great Gunpowder falls over a ridge 205 ft. high into headwaters of Lake Roland, the impounding reservoir on Jones' falls. Two 5,000,000-gall. Worthington pumps forced water through 36-in. main.

GUNPOWDER SYSTEM.

General Description.—Plans adopted in '72 and works completed in '80; gives an additional independent supply. Dam on Gunpowder river, about 9 miles from the city, forms reservoir five miles long called Loch Raven. From this a tunnel

nearly 7 miles long leads to a large reservoir called Lake Montebello, from which a conduit extends a mile to a distributing reservoir known as Lake Clifton. The total cost of this system to Dec. 34, '80, was $4,704,261.

Gunpowder River Dam and Loch Raven Reservoir.— Cap., 510,000,000 galls.; area, 25 acres; 170 ft. above tide; 5 miles long, 20 ft. deep at dam. Borders of stream have been excavated to original stream-level, material being placed in embankments outside flow-line. Dam of masonry, founded on rock, 556 ft. long, height not given, 65 ft. wide at bottom, 34 ft. at spillway, 10 ft. higher at wings, and the wings extend some distance further. Foundations carried 13 ft below bed of stream into bed-rock; built in three sections by means of coffer dams. *Spillway:* in dam, 300 ft. long. Cost, $250,000.

Tunnel.—From Loch Raven to Lake Montebello; circular, 12 ft. in diam., 36,500 ft. long, with fall of 1 ft. a mile Begun Dec., '75, finished Nov., '80. It is straight throughout its length, from 65 to 300 ft. below surface, and for 6 miles extends through hard blue gneiss rock, for one mile through limestone, in which large quantities of water, many fissures, and several pockets of semi-fluid material were found. Fifteen shafts were sunk, and headings worked at 32 points. Only 11,691 ft. were arched. All drilling done by hand, and blasting by giant powder or dynamite. Cost of excavating $1,382.599; arching, cleaning and filling shafts, $397,011; total, $1,779,610.

Lake Montebello.—Cap., about 500,000,000 galls.; irregular; area, 60 acres; 163 ft. above tide; formed by two embankments across ravine. A stream ran through ravine, but its water being impure, it was diverted around reservoir by an 8-ft. tunnel.

Canduit conveys water from Lake Montebello to Lake Clifton, the distributing reservoir; in tunnel and open cut, 5,391 ft. long.

Lake Clifton Distributing Reservoir.—Cap., 265,000,000 galls.; elliptical, 1,100 x 1,600 ft.; area, 30¼ acres; depth, 31 ft.; elevation, 163 ft. above tide. Provision is made for six 40-in. distributing mains. But two of these mains were first put in use.

Distribution.—*Mains*, c. i., 380 miles. *Services*, 1½ in. c. i. *Taps*, about 68,000. *Meters*, 791. *Indicators*, 330. *Hydrants*, made by department, 1,169. *Valves*, kind, do. *Close of* '60: Mains, 127 miles. Hydrants, 534. *Close of* '70: Mains, 199 2 miles. Meters, 132. Hydrants, 640. *Close of* '80: Mains, 277.8 miles. Meters, 524. Hydrants, 849.

Consumption, about 37,069,250 galls. *Pressure*, 60 lbs.

Financial.—Cost, $11,212,218. Bonded debt, $9,900,000: $263,000 at 6, $8,737,000 at 5, $900,000 at 4%. Total int. paid, '88, $480,630. Ann. op. exp., $106,658. Ann. rev.: consumers, $635,397; city, $5,000, appropriation for hydrants and fountains; also water tax, $18,904. Cost, close '60, $1,605,488. Do., '70, about $5,000,000. Do., '80, about $9,000,000 Rev., '60, $150,162. Do., '70, $291,892. Do., '80, $606,879.

Management.—Seven Comrs. Prest., F. C Latrobe, Mayor. Secy., Jno. F. Hunter. Chf. Engr., Robt. K. Martin. Engr. and Supt., County Division, Wm. L. Kenley. Registrar, E. Shriver.

References.—Further data regarding the Baltimore Water Works is given in *Engineering News*, vols. and pp. indicated—IV., 128, 245; VII., 445; VIII., 428.

NOTE.—Work was begun in the fall of '88 on new reservoir at Guilford; cap. will be about 40,000,000 galls.; Contrs., Jones & Thorn.

CATONSVILLE, *Baltimore Co.* (Pop., 1,712; est., 3,000.) Not incorp. No sewers or electric lights.

History.—Built in '87 by Catonsville Water Co. Engr., Robt. K. Martin, Baltimore.

Water Supply.—Artesian well, and stream, pumping to tanks.

Pumping Machinery.—Dy. cap., 400,000 galls.; deep-well Deane. [750,000 Worthington also reported.] *Boilers*, two 50-H. P.

Tanks.—Cap., 650,000 galls.: two, 185,000 and 485,000: latter added in '89. Contrs. Bartlett & Hayward, Baltimore,

Distribution.—*Mains*, c. i., 8 miles. *Services*, c. i. *Taps*, 145. *Meters*, 4. *Hydrants*, 16.

Consumption, 150,000 galls. *Pressure:* Ordinary, 90 lbs. Fire, 150 lbs.

Financial.—Cost, $70,000, Cap. stock, $60,000. No debt. Ann. op. exp., $1,600. Ann. rev., $4,800. Hydrant rental, $25.

Management.—Prest., J. M. Cone. Sec. and Treas., F. T. Snowden. Supt., Frank A. McCrea.

CENTREVILLE, *Queen Anne Co.* (Pop., 1,196; est., 1,800.) On Corsica river. Incorp. town. No sewers or electric lights.

History.—Built latter part of '89 by town. Engr., R. A. Cairns, N. Y. City. Labor done by the day.

Water Supply.—Stream, filtered, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 750,000 galls.; Knowles.

Filter.—No data.

Stand-Pipe.—Cap., 34,000 galls.; 8 x 90 ft.; from Tippett & Wood, Phillipsburgh, N. J.

Distribution.—(Sept. 14, '89.) *Mains*, 8 to 4-in. c. i., 2 miles. Pipe and specials from McNeal Pipe & Foundry Co., Burlington, N. J. *Hydrants*, Ludlow, 20. *Valves*, Ludlow.

Pressure: Ordinary, 40 lbs. Fire, 100 lbs

Finanical.—(Sept. 14, '89.) Cost, about $17,000. Bonded debt, $17,000; payable in 10 and 17 years. Int., 5%.

Management.—Town Council Treas., W. F. Harman.

CHESTERTOWN, *Kent Co.* (Pop., 2,350; est., 3,000.) On level ground on Chester river, 14 miles from Chesapeake bay, at head of navigation. Has large canning and straw-board factories. Settled over 100 years ago; Washington College located here in 1872. Incorp. Partially sewered. No electric lights.

History.—Built in '85 by Chestertown Water Co. Des. Engr., W. W. Taylor.

Water Supply.—Springs, pumping from collecting to distributing reservoir.

Reservoirs.—Cap., 1,080,000 galls. *Collecting:* cap., 30,000 and 50,000 galls. *Distributing:* cap., 1,000,000 galls.; in excavation, 75 ft. above town.

Pumping Machinery.—Dy. cap., 480,000 galls.; Deane comp., dup. *Boiler:* 50-H. P. steel tubular.

Distribution.—*Mains*, w. i. (in '87), 4 miles. *Services*, galv. i. *Taps*, 200. *Meters* 8. *Hydrants*, Clarks & Registin, 29.

Consumption, 40,000 galls. *Pressure:* Ordinary, 30 lbs. Fire, 50 lbs.

Financial.—Cost, $25,000. Bonded debt, $15,000. Int., 6%. Ann. op. exp., $1,500. Ann. rev.: consumers, $2,000; city, $550. Hydrant rental, $20.

Management.—Prest., C. T. Westcott. Secy. and Treas., M. W. Thomas. Supt., Wm. T. Sutton.

CUMBERLAND, *Alleyheny Co.* (Pop., 10,693; est., 13,000.) On Potomac river, on rolling ground, in center of bituminous coal region. Has glass, iron and steel manufactories; engaged in trade and shipping. Baltimore & Ohio R. R. shops and buildings supplied from works of their own. Has electric lights.

History.—Built in '70-1 by city, and enlarged in '73. Engrs. and Contrs., Holly Mfg. Co., Lockport, N. Y.

Water Supply.—Potomac river, by direct pumping.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; Holly-Gaskill. First pump, and that added in '73, replaced by new one in '80

Distribution.—(In '87.) *Mains*, 3 to 12-in. c. i., about 30 miles. *Services*, ¾ to 1-in., kind not given. Pipe and specials from Gaylord, Covington, Ky.; pipe laid by city. *Taps*, about 1,800. *Meters*, none. *Hydrants*, Holly, 200. *Valves*, Eddy.

Consumption, 2,000,000 galls. *Pressure:* Ordinary, 85 to 90 lbs. Fire, 110 to 130 lbs.

Financial.—Cost, $150,000. Bonded debt, $150,000. Int., 5%. Ann. op. exp., $7,000. Ann rev.: consumers, $10,000. Original cost, $99,864.

Management.—Com. of City Council. Supt., Asa Wilson.

Note.—No reply to inquiries sent in '89.

EASTON, *Talbot Co.* (Pop., 3,005; est., 4,500.) Has some manufactories and considerable trade. Incorp. No sewers. Has electric lights.

History.—Built in '86 by Easton Water Co. of Talbot Co. Engr., Isaac S. Cassin, Philadelphia, Pa.

Water Supply.—Artesian wells, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 600,000 galls.; Gaskill dup. *Boiler:* Harrisburg.

Stand-Pipe.—Cap., 84,600 galls.; 12x100 ft. Contr., Chas. E. Tippett, Harrisburg.

Distribution.—*Mains*, c. i., 6 miles. *Services*, galv. w. i. Pipe and specials from McNeal Pipe and Foundry Co., Burlington, N. J.; pipe laid by Crook, Horner & Co., Baltimore. *Taps*, 230. *Meters*, 1. *Hydrants*, Cassin, 40. *Valves*, Cassin.

Consumption, 50,000 galls. *Pressure:* Ordinary, 45 lbs. Fire, 125 lbs.

Financial.—Cost, $40,000. Cap. stock, $40,000. No debt. Ann. op. exp., $1,400. Ann. rev.: consumers, withheld, est., $2,000; city, $1,000. Hydrant rental, $25.

Management.—Prest., Jos. H. White. Secy. and Supt., Wm. E. Shannahan. Treas., R. B. Dixon.

FREDERICK, *Frederick Co.* (Pop., 8,659.) On level ground surrounded by hills. Small stream called Carroll run flows through center of city. Has manufactories. Settled over 100 years ago. Incorp. city in '05.

History.—Present works built by city prior to '80, date not given, and enlarged in '80. First supply introduced by private Co. from Sawmill branch of Carroll run, and from springs on Mt. Philip farm. These works were abandoned some years ago and works built by city, but neither this date, nor that of building first works, is given.

Water Supply.—Springs, artesian wells, and mountain stream called Great Tuscarora, by gravity.

Conduits.—Water from 9 springs in Catoctin Mts., and two artesian wells is brought by covered drains to a "receiving house," and conveyed thence by 4½ miles of 6-in. c. i. pipe to distributing reservoir. In '80 supply was increased by bringing water to reservoir from Great Tuscarora, through 6½ miles of 8-in. c. i. pipe having fall of 273 ft.

Reservoir.—Cap., 1,900,000 galls.; in excavation and embankment, 125 ft sq., 17 ft. deep, lined with brick; a mile northwest of city and 75 ft. above it.

Supply Mains.—Two 10-in.

Distribution.—*Mains*, 2 to 10-in. c i., 10 miles. *Taps*, withheld, est., 1,000. *Meters*, 1. *Hydrants*, not given.

Consumption, not given. *Pressure*, 15 to 25 lbs.

Financial.—Cost, $125,000. Bonded debt (in '82), $70,000. Int., 5%. Ann. op. exp., withheld, est., $2,000. Ann. rev.: consumers, withheld, est., $10,000.

Management.—Supt., C. N. Hahn.

FROSTBURGH, *Allegheny Co.* (Pop., 4,057; est., 5,000.) On plateau between Savage and Dan's mountains, 1,792 ft. above sea, 17 miles from Cumberland, in bituminous coal region. Settled and incorp. borough in '50. No sewers. Has electric lights.

History.—Built in '54 by Frostburg Water Co. Engr., Nelson Beall, deceased. In '64 improvements were made at source of supply with T. L. Patterson, Cumberland, as Engr.

Water Supply.—Springs and four artesian wells, by gravity from collecting reservoir, with tank for fire protection. Springs are on Savage mountain, one mile from town.

Reservoir.—Cap., est., 1,000,000 galls.; originally 60 ft. sq. x 12 ft. deep, lined with stone. Enlarged in '88 to about four times original cap. by excavating on three sides; addition not lined with masonry.

Supply Main.—C i., 6-in. Originally 4-in. c. i., but in '63 it had become so filled with rust that it was replaced by present main.

Tank.—Cap., not given; wooden, on mountain.

Distribution.—*Mains*, 8 to 4-in. c. i., 4¼ miles. *Services*, galv. i. Pipe and specials from H. J. McShane, Baltimore; R. D. Wood & Co., Philadelphia, Pa.; Atwood & McCaffrey, Pittsburgh, Pa. Trenching done by Co. with day laborers. *Taps*, about 275. *Meters*, none. *Hydrants*, various kinds, mostly cheap, 28. *Valves*, Eddy.

Consumption, 35,000 galls. *Pressure*, 90 to 110 lbs.

Financial.—Cost, $22,000. Capital stock, issued, $10,000; authorized $20,000. Debt, $6,100; bonded, $4,600 at 6%; floating, $1,500. Sinking fund, $1,200. Int., 6%. Ann. op. exp., $350. Ann. rev.: consumers, $1,800; city, $150 for 27 hydrants, or $5.55 each.

Management.—Pres., Secy. and Treas., W. O. Sprigg. Supt., A. Schofield.

HAGERSTOWN, *Washington Co.* (Pop., 6,627; est., 10,000.) In rolling limestone country, between North and South mountains of Blue Ridge range, ¾ miles from Antietam creek. Laid out in 1762 by Capt. Jonathan Hager; incorp. in '14. No sewers. Has electric lights.

History.—Built in '81-2 by Washington County Water Co. Engr., Robt. K. Martin, Baltimore. Asst. Engr., Geo. W. Harris, Hagerstown. Work done by Co.

Water Supply.—Beaver creek at its headwaters on South mountain, 8 miles from town, and artesian wells, by gravity.

Settling Basin.—Cap., 1,500,000 galls.; ¾ miles from confluence of several springs forming creek; an old mill pond.

Dam and Reservoir.—Cap., 20,000,000 galls.; area, 60 acres; 240 ft. above center of town. Dam of gravelly clay, built in layers, rolled, without heart-wall, on curve; 1,500 ft. long, 18 ft. high, 15 ft. water; 15 ft. wide on top, 85 at bottom. Inner slopes, 2 to 1, paved with 8 ins. of cobble stones; outer 1½ to 1, unpaved. *Spillway:* at end 20 ft. wide, 3 ft. deep, in earth, lined with masonry, free; sides vertical.

Influent and Effluent Pipes.—*Influent:* c. i., 3 12-in., each with stop valve. *Effluent:* 8-in. drainage, 20-in. discharge; latter has 5 brick and cem. cut-off walls, that at foot of inner slope 70 ft. long, 5 ft deep. Dam does not leak. Built in '82. Engrs. and Contrs., see History. Cost, $20,000.

Conduit.—To town: 7¾ miles 12-in. c. i., laid 3 feet deep, following surface grade, which is very irregular. There are 8 gates on line.

Distribution.—*Mains*, c. i., 19 miles. *Services*, 1¼-in. c. i. *Taps*, 710. *Meters*, 17. *Hydrants*, Mathews, 56. *Valves*, Ives, Kennedy.

Consumption, 500,000 galls. *Pressure*, 95 lbs.

Financial.—Cost, $150,000. Cap. stock, $80,000. Bonded debt, $40,000. Int., 4%. Original bonds, 5%, replaced by 20-year, 4%. Ann. op. exp., $6,000. Ann. rev.: consumers, $10,000; city, $1,000 for hydrants, or $17.86 each.

Management.—Prest., G. H. Harris. Secy., Edw. Stake. Treas. and Supt., C. F. Manning.

HAVRE DE GRACE, *Harford Co.* (Pop., 2,816; est., 3,500.) On Susquehanna river, near head of Chesapeake bay. Engaged in coal and lumber trade, fruit canning, and shad and herring fishing. Settled before Revolutionary war; incorp. a town in '74. No sewers or electric lights.

History.—Built in '83-4 by Havre de Grace Water Co. Engr., W. W. Taylor, Philadelphia.

Water Supply.—Susquehanna river, pumping to reservoir.

Pumping Machinery.—Dy. cap., 360,000 galls.; Davidson. Blake dup., 6 x 12 ins., was in use in '84. *Boiler:* Babcock & Wilcox.

Reservoir.—Cap., 4,000,000 galls.; area, 1½ acres; 250 ft. above pump, 210 above town.

Distribution.—*Mains*, 4 and 6-in. lap-welded w. i., 3½ miles. *Services*, galv. i. *Taps*, 125. *Meters*, 1. *Hydrants*, Clark's, 30.

Consumption, not given. *Pressure*, 100 lbs.

Financial.—Cost, $20,000. Debt, $15,000. Int., 6%. Ann. op. exp., $1,000. Ann. rev.: consumers, $900; city, $500. Hydrant rental, 5 cents on each $100 of taxable property within city limits, or, av., $30 each.

Management.—Prest., A. P. McCombs. Secy., Chas. Zeitler. Treas., R. K. Vauneman. Supt. and Engr., J. W. Maslin.

MECHANICSTOWN, *Frederick Co.* (Pop., 730; est., 1,000.) Near Monocacy river, 16 miles from Frederick. Engaged in iron and copper mining. Incorp. No sewers or electric lights.

History.—Built in '87 by Mechanicstown Water Co., of Frederick Co. Work done by Co. without Contr.

Water Supply.—Mountain springs, by gravity.

Distribution.—*Mains*, 6-in. c. i., 2½ miles. *Services*, not given. Pipe and specials from Mellert Foundry & Machine Co., Reading, Pa. *Taps*, 85. *Meters*, none. *Hydrants*, Mellert, 18.

Reservoir.—Cap., 300,000 galls.

Consumption, 50,000 galls. *Pressure*, 80 lbs.

Financial.—Cost, $9 800. Cap. stock, $10,000. No debt. Ann. op. exp., $100, Ann. rev.: consumers, $400; city, $216. Hydrant rental, $12.

Management.—Prest., Van B. Osler. Treas., Geo. W. Stocksdale. Secy. and Supt., S. M. Birely

SALISBURY, *Wicomico Co.* (Pop., 2,581; est., 3,500.) On Wicomico river. Engaged in lumber trade, fruit raising and market gardening. Incorp. Has sewers and electric lights.

History.—Built in '88 by Salisbury Water Co. Engr., L. S. Bell. Work done by Co. Original drawings and specifications by Isaac S. Cassin, Philadelphia.

Water Supply.—Twelve 6-in. wells for domestic use, and Wicomico river for fire protection, pumping to stand pipe and direct.

Pumping Machinery.—Dy. cap., 650,000 galls.; Hughes comp., dup., direct-acting.

Stand-Pipe.—Cap., 4,600 galls.; 12 x 100ft.; from Tippett & Wood, Phillpsburgh, N. J.

Distribution.—*Mains*, 8 to 3-in., c. i., 4½ miles. *Services*, galv. i., lead. Pipe and specials from Mellert Foundry & Machine Co., Reading, Pa. *Taps* 85. *Meters*, none. *Hydrants*, Chapman, Mellert, 7. *Valves*, Chapman, Ludlow, Eddy.

Consumption, 27,000 galls. *Pressure:* Ordinary, 50 lbs. Fire, 125 lbs.

Financial.—Cost, $27,500. Cap. stock, $8,350. Debt, $15,000. Int., 4%. Ann. op. exp., $1,000. Ann. rev.: consumers, $1,500; city, $750. Hydrant rental: city, $25; private, $30.

Management.—Prest., S. P. Dennis. Secy. and Supt., L. S. Bell. Treas., L. E. Williams.

UNION BRIDGE, *Carroll Co.* (Pop., 579; est., 1,100. Has shops and grain elevators of Western Md. R. R. Incorp. No sewers or electric lights.

History.—Built in '86-7 by Union Bridge Water Co. Engr., Edw. D. Crook, Baltimore. Contrs., Crook, Horner & Co., Baltimore.

Water Supply.—Springs, pumping from receiving to distributing reservoir.

Receiving Reservoirs.—*Old:* no data. *New:* cap., 80,000 galls.; built in '88.

Pumping Machinery.—Dy. cap., 250,000 galls.; Worthington comp.

Distributing Reservoir.—Cap., 400,000 galls.; in embankments 15 ft. high; 110 ft. wide [or sq.] at top, 50 at bottom. Inner slopes lined with clay, riprapped from top 7 ft. down. Engrs., see History. Contrs., Conway & Bates. Baltimore. Cost, $2,300. Built in '86.

Distribution.—*Mains*, 4 and 6-in., c. i., 2¾ miles. *Services*, ¾-in. galv. i. *Taps*, 110. *Meters*, none. *Hydrants*, Mathews, 18. *Valves*, Peet.

Consumption, 50,000 galls. *Pressure:* Ordinary, 40 to 60 lbs. Fire, 140 lbs.

Financial.—Cost, $17,600. Cap. stock, $12,000. Bonded debt, $5,000. Ann. op. exp., $300. Ann. rev.: consumers, $550; city, $350.

Management.—Prest., M. C. McKinstry. Secy. and Treas., Jno. S. Repp. Supt., J. M. Hollenberger.

WESTMINSTER, *Carroll Co.* (Pop., 2,507; est., 3,000.) On rolling ground at the headwaters of the Patapsco river, 29 miles from Baltimore. Has manufactories. Settled in 1775; incorp. town in '58. No sewers or electric lights.

History.—Built in '83 by Westminster Water Co. Engr., W. W. Taylor, Philadelphia. Contr. for masonry, C. Awalt; for buildings, Geo. Lease.

Water Supply.—Three springs, pumping from receiving to distributing reservoir. Springs are one mile from town.

Collecting Conduits.—Earthenware pipes. No further data.

Receiving Reservoir.—Cap., 500,000 galls. Screens at outlet.

Pumping Machinery.—Dy. cap., 118,000 galls.; Worthington.

Reservoir.—Cap., 1,000,000 galls.; 12 x 150 ft., in earth embankment, puddled and riprapped; 145 ft. above pump, 180 above lowest point in town.

Distribution.—*Mains*, c. i., 5 miles. *Services*, galv. i. Pipe and specials from Ives & Co., Baltimore; trenching and pipe-laying done by Geo. Harris, Hagerstown. *Taps*, 300. *Meters*, 5. *Hydrants*, kind not given, 40.

Consumption, 12,000 galls. *Pressure:* Ordinary, 55 lbs. Fire 100 lbs.

Financial.—Cost, $25,000. Total cap. stock, $25,000; $5,000 preferred. Bonded debt, $20,000. Int., 6%. Ann. op. exp., $1,000. Ann. rev.: consumers, $2,000; city, $900, Hydrant rental, 5 cents on each $100 of taxable property in city limits, or av., $22.50.

Management.—Prest., Wm. A. McKellip. Secy., A. H. Huber. Treas., Wm. B. Thomas. Supt., Alex. Klinedenst.

Water-Works Projected with Fair Prospects of Construction.

CAMBRIDGE, *Dorchester Co.* (Pop., est., 3,800.) On Choptank river, 20 miles from Chesapenke Bay. Engaged in oyster and lumber trade.

Proposed Works.—Several propositions made by private parties in '89. Supply, [probably] well, pumping to tank. Latest report, Oct. 10, '89.

Water-Works Projects Reported in '89 and '90, but Now Indefinite.

Ellicott City, Howard Co., see MANUAL for 1888, p. 213. *St. Michael's*, Talbot Co., *Lawson*, Baltimore Co.; see MANUAL for 88, p. 243.

DISTRICT OF COLUMBIA

Water-Works Completed.

WASHINGTON and GEORGETOWN. (Pop.: Washington, 147,293; Georgetown, 12,578. Total, 159,871.) Washington is on Potomac river at head of tide-water, 184 miles from ocean. It has a water front of about 4 miles on Potomac river, and 3¾ miles on eastern branch. Most of city is flat, with slight elevation, but Capitol is 89.5 ft., and some points 104 ft., above mean tide. Georgetown is west of Washington, separated from it by Rock creek. Some points in its surface are 200 ft. above tide. Washington incorp. in '02; pop., 4,000.

History.—Built in '53-9 by U. S. Government. Engr., Capt. M. C. Meigs, Corps of Engrs., U. S. A. In '63 Potomac water was introduced, dam at Great Falls having been built after plans of Silas Seymour. July 15, '82, Congress approved an act "to increase the water supply of the City of Washington" by extending Great Falls dam, building a large reservoir, connecting old and proposed new reservoir by tunnel, and laying proper distributing mains from new reservoir to city. Contracts for work were let in fall of '83. Dam was finished in Aug., '86, reservoir nearly or quite so in '87, and tunnel in '88. New work has been under direction of U. S. Engrs. System outside city and for supplying the Government buildings is under control of U. S., and distribution system is managed by municipal authorities.

Water Supply.—Potomac river, by gravity, with pumping to reservoir and direct for high service supply. A large dam across river 17 miles from the city forms an impounding reservoir, from which aqueduct conveys water 9 miles to receiving reservoir, thence two miles to a distributing reservoir.

From Jan., '59, to Dec., '63, supply was from present receiving reservoir, which is formed by dam across Powder Mill branch, a stream having a drainage area of over 4,000 acres. In '64-5 conduit was built from inlet to outlet of receiving reservoir, so water from Powder Mill stream need not be used when muddy. Similar method was carried out at distributing reservoir, which makes possible direct distribution from the aqueduct.

Dam.—Across Potomac river at Great Falls. Begun in '63 or '64, and in '67 was finished as it stood until extended in connection with new works. It was built of cut stone masonry, backed with riprap, was 1,034 ft. long, with its top 146¾ ft. above tide-level at Washington Navy Yard. This reached across the two northern channels of river to Conn's island. Late extensions cross island with a masonry dam about 4 ft. high, and other channel to Virginia shore with a max. height of 20 ft. Length of new part is 1,843 ft., making present total length of dam 2,877 ft. Old dam was raised by a coping to height of the new part, 148 ft. above tide. Contrs. for new dam, Chittenden Bros. Contract price, $91,293.75.

Aqueduct.—From river culvert was built under Chesapeake & Ohio R.R. to a gate-house. Here water passes into aqueduct, which is 9 ft. in diam., has a grade of 0.791 ft. to mile, and has its invert at dam 151 ft. above tide-level. Material used was either rubble masonry or brick, according to cost at given point, in hydraulic cem. Thickness of brick ring, 1 ft. The greater part of the aqueduct is in cut, bottom section of which is carefully dressed to semicircular form and ring laid upon earth. All embankments carefully built to level with center of conduit, left a season for settling, then excavated for lower half of conduit, ring here also being laid on earth. Before water was let in cracks appeared in conduit, but although some parts of aqueduct have settled a foot no serious breaks have occurred. Nine miles from dam conduit enters receiving reservoir and is continued two miles to distributing reservoir.

Griffith Park and Cabin John Bridges: aqueduct crosses valleys of two streams on masonry bridges. Griffith Park bridge is an elliptical arch, 75-ft. span, 15 ft. rise. Cabin John bridge is a segmental arch, 220 ft. span at elevation of 101 ft. above water in creek; rise, 57.25 ft. This is the longest, but one, single-span masonry bridge in the world. Voussoirs of bridges are of dressed Quincy granite with a superimposed arch of squared sandstone. Brick conduit is carried over bridges, backing being of rubble masonry, and sidewalls of bridges of squared sandstone. When water was first admitted aqueduct leaked badly on Cabin John bridge; leak was stopped by cleaning conduit at this point and backing lower half of its inside with hatchets, until rough, then plastering it with two coats of Rosendale cement mortar, well rubbed on. Second coat was applied before first was dry, and the two were ¼ in. thick.

Receiving Reservoir.—Cap., 176,000,000 galls. above bottom of outlet; 9 miles from dam on Potomac; area, about 50 acres, formed by damming Powder Mill branch. No description of dam. Distance between conduit inlet and outlet, 3,600 ft., which has been connected as already stated.

Distributing Reservoir.—Cap., 150,850,000 galls. Two miles from receiving reservoir, in excavation and embankment, in two divisions, nearly rectangular, with water surface of 43 acres at flow-line, which is 146 ft above tide. Inner slopes lined with dry walls, 12 to 18 ins. thick, laid on 6 ins. broken stone. Conduit connecting influent with effluent gate-houses on north side, 7 ft. in diam.

Supply Mains.—Originally three lines led to city from this reservoir, of 12, 30 and 36-in. pipe.

College Pond and Rock Creek Bridges.—College pond is crossed by two 30-in., flanged c. i. pipes, arched, span being 120 ft. Rock creek, between Washington and Georgetown, is crossed by a bridge of 200 ft. span and 20 ft. rise, composed of two ribs of 48-in. c. i. pipes, 1½-in. thick, flanged and bolted together, supporting iron trusses on which roadway is carried. From '62-76 horse car track was carried on this bridge. Since '76 passage of heavily loaded wagons and carriages has been forbidden. Pipes of the arch were at first lined with wooden staves to prevent freezing, but lining was soon removed.

GEORGETOWN HIGH SERVICE.

Pumping Machinery.—The pump lately at the Washington high service station has been placed here, and is probably the 2,000,000-gall. Worthington pump erected at the former station in '79. From '60 to '75 a Worthington water-power pump was used. It was placed in one of the abutments of the Rock creek bridge, and driven with water from the supply main.

Reservoir.—Brick, hemispherical, 120 ft. in diam. and 220 ft. above tide. This reservoir leaked considerably, owing to defective arrangement of influent and effluent pipes. It supplies that part of Georgetown more than 90 ft. above tide-level.

WASHINGTON HIGH SERVICE.

Pumping Machinery.—Dy. cap., 5,000,000 galls.; two 2,500,000 Gaskill horizontal. *Boilers:* Holly. All placed in '87. About nine-tenths of pumping here is direct, remainder being to stand pipe erected in '79.

Stand-Pipe.—No data.

NEW TUNNEL AND RESERVOIR, BUILT '84-8.

New Aqueduct Tunnel.—Connecting old and new distributing reservoirs; 20,715 8 ft. long; cross-section, 11 ft. wide by 7½ ft. high. Area, lined, 76.34 sq. ft.; unlined, 82½ sq. ft. Sunk from five shafts, through rock. Shafts to tunnel grade have depths of 97, 69, 58½, 137¼ and 162 ft., first being at inlet, and the last at outlet. Most of excavation for shafts was done by hand, but for that in tunnel Ingersoll "Eclipse" rock drills were used. These were worked by compressed air carried to the drills by 12 to 4-in. pipes, about 10 miles of pipe being required for work. (See References, below.) Contrs. for tunnel, Beckwith & Quackenbush. Contract price, exclusive of lining, which could not be estimated, was $548,100. Owing to changes of plan and rise in prices of material and labor an additional appropriation, of $395,000 was made in '85. June 30, '87, when tunnel was "holed," $875,697 had been expended. Total of appropriations to that date, $999,535. Congress not making further appropriation work was abandoned from fall of '87 until after Mar. 30, '88, when $335,000 more was appropriated, and work resumed. Soon after a supplemental contract was made, involving some changes, but providing for completion of tunnel Nov. 1, '88. Charges of bad work in lining having been made, Congress, Oct. 19, '88, ordered all work suspended and appointed a joint investigating Com., with Geo. F. Edmunds, Chn. This Com. selected Jos. M. Wilson, Philadelphia, Henry Flad, St. Louis, Fredk. Graff, Philadelphia, as expert engrs. to examine aqueduct and report. The experts found the lining and back-filling so defective as to render the aqueduct unsafe without repairs est. at $929,720. Even after such repairs the experts feared excessive leakage, and so recommended the virtual abandonment of the work, and the substitution of either a 6-ft. steel conduit within the aqueduct, or, as an equivalent, three 4-ft. c. i. gravity mains laid on surface and under Rock creek. Est. cost of steel conduit, with dy. cap. 33 000,000 galls., $852,786; of three 4-ft. c. i. conduits, 11,000,000 galls. each, $1,178,650. For immediate use it was suggested that one 4-ft. c. i. main could be laid between the two reservoirs for $598,000. In Apr., '88, contracts for the material for this line were let; half of 48-in., and small amount of

smaller pipe to Gloucester Iron Works, Philadelphia; remainder of 48-in. pipe to Camden Iron Works, Philadelphia; specials to McNeal Pipe & Foundry Co., Burlington, N. J. Contr. for trenching, Thos. Cowles; work begun as early as Aug., '89.

Reservoir.—Cap., about 300,000,000 galls.; star shaped; area, 67 acres; 30 ft. of water above flow-line. Contrs., Maloney & Gleason. Price, $208,080.

Connections with city distribution: From effluent gate of new reservoir a 75-in. c. i. pipe extends 661.6 ft. and terminates in three 48-in. branches, only one of which was intended for immediate use. From here 48-in. pipe leads to old 36-in. main. Connection between these two was made by a special three-way casting, water being cut off but 45 hours and 50 minutes for the operation. The 75-in. pipe was furnished by the West Point Foundry Association, West Point, N. Y., and the 48, 12, 8 and 6-in., with special castings, by A. H. McNeal, Burlington, N. J.

Distribution.—(June 30, '88.) *Mains*, c. i., 186 miles. *Services*, galv. i. *Service connections*, 27,639, there being 23,489 taps. *Meters*, Crown, Worthington, 14. *Fire hydrants*, kind not given, 1,017 *Street hydrants*, 280; these supply av of 30 families each; no rev. from them.

Consumption, 26,518,914 galls.; an av. for 8 years, from '81 to '87, inclusive, of measurements made for each hour in one of last days of June. Assuming pop. supplied as 200,000, consumption per capita per day is 133 galls.

Pressure, 18 to 24 lbs.

Financial.—(June 30, '88.) Cost about 8,500,000. Debt (in '85), $875,000. Int., 3%. Ann. op. exp., $60,191. Ann. rev.: consumers, $180,884; taxes, $34,265.

Management.—Engr. Comr. of D. C., Maj. J. C. W. Raymond. Asst. to Engr. Comr., D. C., Capt. Jas. L. Lusk.

References.—To *Engineering News*: describing new tunnel, and compressed air plant used for drilling, with illustrations, vol. XI., p. 75; also regarding the tunnel, vols., XI., p. 23, XV., 253, XVI., 159. Leaks and breaks in mains, vol. XVII., pp. 33, 247, 418, and break in 36-in. main, XX., p. 21. Reservoir in connection with new tunnel, vol. XI., p. 4. Suit for injunction against extending dams across Virginia channel of Potomac (defeated), vol. XIV., p. 123. Description of new dam, tunnel and reservoir, vol. XIII., 105. In papers on Municipal Engineering, Washington, vol. XVI., pp. 182-83, and pp. 196-7. The latter gives department specifications for c. i. water-pipe, details of bell and spigot joint, and descriptions and illustrations of distribution system. Details from joint investigating com.'s report on condition of new aqueduct, vol XXI., pp. 403, 421.

GROUP 3.—South Atlantic States.—Water-Works Completed, in Process of Construction or Projected, in Virginia, West Virginia, North Carolina, South Carolina, Georgia and Florida.

VIRGINIA.

Water-Works Completed or in Process of Construction.

ABINGDON, *Washington Co.* (Pop., 1,064; est., 2,700.) Is 14 miles from Bristol, in farming district.

General Description.—Built in '89-90 by Abingdon Water-Works Co. Contrs., Glamorgan Co., Lynchburgh. Secy. and Treas., R. M. Page. Report, Apr. 3, '90.

ALEXANDRIA, *Alexandria Co.* (Pop., 13,659; est., 16,000.) On South bank of Potomac river, 6 miles below Washington, D. C. Ground rises from river to elevation of 50 ft. Engaged in coal trade, foreign and domestic commerce and manufacturing. Has good harbor. Founded about 1780.

History.—Built in '58 by private company, when pop. was about 9,000. Des. Engr., Frederick Erdman.

Water Supply.—Cameron's run, pumping to reservoir.

Dam.—Power for pumping was first furnished by a mill dam, which was swept away by a freshet in '67, but a small dam above gave necessary power until washed away during the war. Third dam was seriously damaged during a storm in '67.

Pumping Machinery.—Dy. cap., not given. When works were built 20-ft. water-wheel drove 10 x 120-in., double-acting pump. In '55 steam pump was added. No later data.

Reservoirs.—Cap., est., 11,000,000 galls. *No.* 1: cap., est., 3,000,000 galls.; 200 ft. sq., 16 ft. deep, 96 ft. above the tide; in two divisions. A 10-in. main led to city. During war a slide occurred in its bank, and in '67 a storm damaged it. *No.* 2: cap., est., 8,000,000 galls.; in excavation and embankment, 300 x 500 ft., 17½ ft. deep. In '79 slight leaks were reported. Built in '74. Des. Engr., Washington Blythe.

Distribution.—(In '81.) *Mains*, c. i., 15.9 miles. *Services*, not given. *Taps*, 573. *Metres*, not given. *Hydrants*, kind not given, 147.

Consumption (in '81), 803,468 galls. *Pressure*, not given.

Financial.—Original cost, $88,000. From '51 to Jan., '59, total exp. were $125,399; rev., $46,162. In '79 exp. were $4,241; rev., $14,631. No other financial data.

Management.—Supt., Francis Power.

NOTE.—All inquiries addressed to the Co since '81 have been ignored.

BRISTOL, (*Bristol, Tenn., P. O.*) *Washington Co.* (Pop., 1,562; est., 3,000.) Incorp. town. No sewers. Has electric lights.

History.—Built in '89 by city; put in operation July 15. Engrs. and Contrs., Glamorgan Co., Lynchburgh.

Water Supply.—Mountain stream, by gravity.

Reservoir.—Cap., 1,000,000 galls.

Distribution.—*Mains*, 10 to 6-in. c. i., 7 miles. *Meters*, none. *Hydrants*, Mathews, 40. *Valves*, Eddy.

Financial.—Cost, $30,000. Debt, $30,000 Int., 6%.

Management.—Not given.

CHARLOTTESVILLE, *Albemarle Co.* (Pop., 2,676; est., 6,000.) In agricultural and fruit growing district; engaged in manufacturing. Incorp. No sewers. Has electric lights.

History.—Built in '86 by town. Reservoir built jointly by town and University of Virginia, latter paying about $250,000. Des. Engr., E. W. Bowditch, Boston. Contrs., McConnell & Hickler, Buffalo.

Water Supply.—Surface water and springs, by gravity from reservoir.

Reservoir.—Cap., 192,000,000 galls.; about 5 miles distant.

Distribution.—*Mains*, iron, 15 miles. *Services*, w. i. Pipe and specials from Newark Foundry Co. *Taps*, 450. *Meters*, none. *Hydrants*, Chapman, 60. *Valves*, Chapman.

Consumption, 10,000 galls. *Pressure*, 100 lbs.

Financial.—Cost, $115,000. Bonded debt, $70,000. Int., 6%. Sinking fund, $6,000. Ann. op. exp., $900. Ann. rev.: consumers, $5,000; city, none.

Management.—Com. of three. Supt., T. I. Williams.

CHATHAM, *Pittsylvania Co.* (Pop., 543; est., 1,200.) In tobacco growing and mineral region. Incorp. No sewers or electric lights.

History.—Built in '88 by town. Engr., L. H. Pigg. Contr., W. H. Ford.

Water Supply.—Direct from springs.

Reservoir.—Cap., 67,500 galls.; 30 x 30 ft., x 10 ft. deep.

Distribution.—*Mains*, iron, 2 miles. *Taps*, 4. *Meters*, none. *Hydrants*, 4, *Consumption*, 1,000 galls. *Pressure*, 38 lbs.

Financial.—Cost, $7,000. Cap. stock, $7,000. Debt, not given. Int., 6%. Ann. op. exp., $25.

Management.—Supt., C. E. Holt.

CLIFTON FORGE, *Alleghany Co.* (Pop., est., 2,800.) Incorp. town. No sewers or electric lights.

History.—Built in '89-90 by Clifton Forge Water Co.; put in operation about April 1, '90. Des. Engr., W. S. Hungerford. Const. Engr., Edmund Grover, Iron Gate.

Water Supply.—Smith's creek, pumping to reservoir.

Pumping Machinery.—Dy. cap., 500,000 galls.; Gordon, 8 x 12-in. dup.

Reservoir.—Cap., 300,000 galls. Contr., B. C. Bargamin, Staunton.

Distribution.—*Mains*, 6 to 3-in. c. i., length, not given; from Glamorgan Co., Lynchburgh; laid by B. C. Bargamin. *Services*, w. i. *Hydrants*, 10.

Financial.—No debt. Hydrant rental, $25.

Management.—Address Edmund Grover, Iron Gate, or E. M. Nettleton. Latest report, Mar. 13, '90.

COVINGTON, *Alleghany Co.* (Pop., 436; est., 800.) Incorp. town. No sewers or electric lights.

History.—Built in '89 by Covington Water Co.; put in operation Oct. 1. Des. Engr., G. B. Bell. Contrs., Barry & Smith, Richmond.

Water Supply.—Spring branch, by gravity.

Reservoir.—Cap., 300,000 galls.

Distribution.—*Mains*, c. i., 3 miles. *Services*, ¾-in. i. *Meters*, none. *Hydrants*, Mathews, 11. *Valves*, Eddy.

Pressure, 72 lbs.

Financial.—Cost, $8,500. Cap. stock, $8,500. No debt. Hydrant rental, $25.

Management.—Prest., E. M. Nettleton, Covington. Secy., O. L. Rogers. Treas., R. L. Parish. Supt., J. S. Howe. Report, Jan. 6, '90.

CREWE, *Nottoway Co.* (Pop., est., 1,000.) A new town on the Norfolk & Western R. R. Not. incorp.

History.—Built in '88 by Virginia Co. Const. Engr., H. C. Macklin, Roanoke. Contrs., Glamorgan Co., Lynchburg.

Water Supply.—Four springs, pumping to tank.

Pumping Machinery.—Dy. cap., 400,000 galls.; Gordon dup.

Tanks.—Cap., 40,000 galls.; two 20,000; from Motive Power Dept., Norfolk & Western R. R.

Distribution.—*Mains*, 6 and 4-in. c. i., 4 miles. *Services*, not given. *Taps*, 68. *Meters*, none. *Hydrants*, Mathews, 14. *Valves*, Chapman.

Consumption, 125,000 galls. *Pressure*, 30 lbs.

Financial.—Cost, $20,000. Debt and int., not given. Ann. op. exp. and rev., not determined time report. Hydrant rental, none.

Management.—Supt., Malcolm W. Bryan.

DANVILLE, *Pittsylvania Co.* (Pop., 7,526; est., 13,000.) On Dan river in agricultural and tobacco raising district. Has two flour and several cotton mills.

History.—Built in '75, and purchased in '76 by city for $140,000, including gas-works. Engr., C. A. Ballou.

Water Supply.—Dan river, pumping to reservoir and direct.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; Worthington.

Reservoirs.—Cap., 6,500,000 galls.; old, 1,500,000; new, built in '88, 5,000,000 galls.

Distribution.—*Mains*, 3 to 16-in. c. i., length not given; est., 15 miles. *Services*, lead. Pipe and specials from R. D. Wood & Co., Philadelphia, and labor done by city. *Taps*, 760. *Meters*, none. *Hydrants*, Ludlow, 87. *Valves*, Ludlow.

Consumption, 1,000,000 galls. *Pressure*, 65 lbs.

Financial.—Cost, for gas and water-works, about $320,000. Debt, do, $320,000; $140,000 at 8% int., remainder at 5 and 6%. Ann. op. exp., $8,300. Ann. rev.: total, about $13,000.

Management.—Com. of three. Secy., T. S. Williamson. Supt., C. A. Ballou.

FORTRESS MONROE, *Elizabeth City Co.* (Pop., 400.) Has sewers. No electric lights.

History.—Built in '84-5 by U. S. Government. Contrs., Sullivan & Conroy, Providence, R. I.

Water Supply.—"1¼ Points," pumping to tank.

Pumping Machinery.—Dy. cap., about 200,000 galls.; Deane dup. *Boiler:* tubular.

Tank.—Cap., 72,000 galls.; 28 x 22 x 15½ ft.

Distribution.—*Mains*, 6-in. w. i., 1¼ miles. *Services*, do. *Taps*, 140. *Meters*, not given. *Hydrants*, Kennedy, Pratt & Cody, 20. *Valves*, kind, do.

Consumption, 20,000 galls. *Pressure*, 25 lbs.

Financial.—Cost, about $40,000. No debt. Ann. op. exp., $1,216. No rev

Management.—Col. Charles Bird. Engr., Richard Bond.

FREDERICKSBURGH, *Spottsylvania Co.* (Pop., 5,010; est., do.) On Rappahannock river, at head of navigation, on plain slightly above river, and surrounded by hills. Has manufactories and is a trade center. Settled in 1727; incorp. village in 1727; borough in 1781, city in '70. No sewers. Has electric lights.

COMPANY'S SYSTEM.

General Description.—Built in '32 after plans by Alex. Henderson, taking supply from Poplar springs, 1½ miles from town. *Distribution:* (in '82) Mains, c. i., 4 miles. Services, lead. Taps, 225. Hydrants, none. Cost (in '82), $25,000. Cap. stock, do., $17,000. Prest., A. M. Wallace. Supt., R. E. Stoffregan.

CITY'S SYSTEM.

History.—Built in '84-5.

Water Supply.—Rappahannock river, pumping to reservoir.

Pumping Machinery.—Dy. cap., 400,000 galls.; Blake.

Reservoir.—Cap., 4,000,000 galls.

Distribution.—*Mains*, c. i., 10 miles. *Services*, galv. i., lead. *Taps*, 725. *Meters*, 1. *Hydrants*, Eaves & Bro., 51.

Consumption, 300,000 galls. *Pressure:* Ordinary, 56 lbs. Fire, 100 lbs.

Financial.—Cost, $30,000. Bonded debt, $30,000. Int., 6%. Ann. op. exp., about $3,500. Ann. rev.: consumers, $4,000; city, none.

Management.—Supt., S. J. Quinn.

GOODSON, (*Bristol, Tenn., P. O.*) *Washington Co.* See Bristol, Va.

GORDONSVILLE, *Orange Co.* (Pop., est., 1,500.) Has manufactories, Incorp. town. No sewers or electric lights.

History.—Built in '89 by town; put in operation Nov. 27. Des. Engr., J. S. Lipscomt, Gordonsville. Const. Engr., Jas. Allen, Lynchburgh. Contr., Jno. Jacoby, Bridgeport, Conn.

Water Supply.—Springs, by gravity.

Reservoir.—Cap., 800,000 galls.; in two sections.

Distribution.—*Mains*, 6 and 4-in. c. i., 2¼ miles; from Glamorgan Co., Lynchburgh. *Hydrants*, Ludlow, 14. *Valves*, Ludlow.

Financial.—Cost, $1,100. Debt, $1,200. Int., 6%.

Management.—Supt., W. H. Porter.

HAMPTON, *Elizabeth City Co.* (Pop., est., 3,000; to be supplied, est., 8,000.) Is 2½ miles from Old Point Comfort and Fortress Monroe. Engaged in trade. Incorp. No sewers or electric lights.

History.—Built in '89 by Hampton Water Co. Supplies National Soldiers' Home with 200,000 galls. dy., and hopes to supply Chesapeake City and hotels at Old Point Comfort. Engr., Ed. D. Crook, Baltimore, Md. Contrs., Holtzclaw Bros., Washington, D. C.

Water Supply.—Gang-wells, by direct pumping; stand-pipe may be added.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two 1,000,000-gall., Deane.

Distribution.—*Mains*, c. i., 5 miles. *Services*, galv. i. Pipe and specials from, and laid by, Crook & Horner, Baltimore, Md.

Pressure: Ordinary, 60 lbs. Fire, 150 lbs.

Financial.—Cost, $60,000. Cap. stock, $100,000. No bonds.

Management.—Prest., C. T. Holtzclaw. Secy., H. R. Booker. Treas., Jas. A. Watkins, Fortress Monroe. Supt., Ed. Norris.

HARRISONBURGH, *Rockingham Co.* (Pop., 2,831; est., 3,200.) In agricultural region; a trade center. Incorp. No sewers or electric lights.

History.—Built in '88-9 by town. Contrs., R. D. Wood & Co., Philadelphia.

Water Supply.—Artesian wells, pumping to reservoir.

Reservoir.—Cap., 1,000,000 galls.; elevation, 110 ft.

Pumping Machinery.—Dy. cap., 144,000 galls.; Knowles.

Distribution.—*Mains*, c. i., 4 miles. *Services*, galv. i. *Taps*, 25. *Meters*, not given. *Hydrants*, kind not given, 32.

Consumption and *Pressure*, not given.

Financial.—Cost, $25,000. Bonded debt, $25,000. Int. 6%.

Management.—Town Council. Supt., P. S. Thomas.

JEFFERSONVILLE, (*Tazewell P. O.*) *Tazewell Co.* See Tazewell.

LEESBURGH, *Loudoun Co.* (Pop., 1,726; est., 2,000.) Is 38 miles west of Washington and 2 miles from Potomac River.

History.—Built in '45 by village.

Water Supply.—Rock spring, by gravity. Spring forms a pool 18 x 86 ft., x 4 ft. deep, inclosed.

Distribution.—*Mains*, iron, about 4 miles. Pipes extend all along streets, and water is generally taken from street hydrants and pumps, being "free to all." When desired connections are made with houses and manufactories "at an almost nominal rate." Fire protection provided by cisterns with cap. of from 6,000 to 10,000 galls., on all streets.

Financial.—Original cost in '45, $18,000. Ann. op. exp., about $200. Ann. rev.: not given, but small.

Management.—Water Board of three. Chn., G. R. Head. Recorder, Arthur Sheetz.

LEXINGTON, *Rockbridge Co.* (Pop., 2,771; est., 3,500.) On fork of James river, in fertile limestone valley. Incorp., 1778. Has sewers. No electric lights.

History.—Owned by town. Date built not given. New works finished in '85, with Jno. McCormick as Engr., and —— Davin, Lexington, Contr.

Water Supply.—Springs, by gravity to and from receiving well and reservoir.

Collecting Conduits.—From springs to receiving well. In '88 additional conduit, about 3¼ miles long, was laid from Connor's spring to well. Contrs. for pipe, Glamorgan Pipe Foundry, Lynchburgh.

Receiving Well.—Adjacent to reservoir, 10 ft. in diam., about 14 ft. deep. Surplus passes to reservoir.

Reservoir.—Cap., 2,500,000 galls.; in excavation and embankment, 210 ft. in diam.; depth, about 14 ft. Banks 10 ft. wide on top, no heart-wall. Inner slopes and bottom riprapped, then grouted with cem. *Pipes:* 12-in. pipe leads from well to reservoir, to convey surplus; also 12-in. wash-out and 8-in. waste-pipe.

Supply Main.—Diam., 8 ins.

Distribution.—*Mains*, c. i., about 6 miles. *Services*, w. i. *Taps*, 350. *Meters*, none. *Hydrants*, Bailey, 19. *Valves*, Eddy.

Consumption, about 90,000. *Pressure:* Ordinary, 60 lbs. Fire, 140 lbs.

Financial.—Cost, about $45,000. Debt, $37,500. Int., 6%. Ann. op. exp., $800. Ann. rev.: consumers, $3,000; city, none.

Management.—Supt., Jos. B. Holmes.

LIBERTY, *Bedford Co.* (Pop., 2,191; est., 3,500.) Manufactures woolen goods, flour and tobacco. Incorp. No sewers or electric lights.

History.—Built in '85 by town. In fall of '89 $10,000 was voted for construction of reservoir.

Water Supply.—Mountain spring, by gravity.

Distribution.—*Mains*, c. i., 12 miles. *Services*, lead. *Taps*, 350. *Meters*, none. *Hydrants*, kind not given, 32.

Consumption, 150,000 galls. *Pressure*, 80 to 140 lbs.

Financial.—Cost, $15,000. Bonded debt., $42,400. Int., 6%. Ann. op. exp., $500. Ann. rev.: consumers, $3,200.

Management.—Supt., W. F. Fitzpatrick.

LYNCHBURGH, *Campbell Co.* (Pop., 15,959; est., 25,000.) On James river on steep hillside rising from river and breaking into numerous hills. Railroad center in Virginia iron belt Has tobacco manufactories, iron furnaces and flouring mills. Laid out in 1786. Incorp. Has sewers and electric lights.

History.—Partially supplied in 1799; general supply introduced in '11; works built by city in '28, reconstructed in '79.

In 1799 "The Lynchburgh Fire Co." obtained leave from village trustees "to sink wells and erect pumps on Main street for the convenience and safety of the citizens." Little was done by this Co., and in '11 council granted to Jno Lynch the privilege of conveying water in wooden pipes through streets from springs at head of Hosford branch.

Town had reserved right to use water for fire protection, and in '13 built a reservoir 12 ft. sq. near market-house and set four fire-plugs. Water was brought about 4,000 ft., under 40 ft. head, from springs to reservoir, and distributed for about 2,500 ft. on Main street. Pipes were 10-in. logs, 3-in. bore, 10 ft. long, jointed like modern pump-logs, and banded at joints with iron. A log house built over reservoir was removed in '30. In '17 Jno. Lynch sold his rights to Jas. Wade. In '28 all but two lengths of the wooden pipes were taken up, and these were found while making sewer excavations in '69. They were well preserved, and were secured by city Engineer Forsberg, but were stolen by negroes for fuel.

In '28, pop. being about 5,000, water-works were built by town. Engr., Albert Stein.

In '68, '79, '81, '82 and '88 pumps were added, and in '77-9 works were reconstructed with A. Forsberg as Engr. Other historical details are given below.

Water Supply.—James river, pumping to low and high-service reservoirs.

Supply introduced in '28 was from James river, by water-power from an impounding reservoir.

In '35 James River & Kanawha Canal Co. contracted to keep water-works, dams, canals, and races perpetually in repair, and to supply not more than 600,000 galls. a day for consumption and enough water for power to raise that amount to reservoirs.

In '70 a freshet so injured canal that city's supply was cut off and Canal Co. could not repair its works without a $35,000 loan from city, for which they assigned to city all leases for water drawn from canal. In '77 another freshet caused damage which was repaired by a second loan from city, this time of $15,000, secured by second mortgage bonds on canal property. The Richmond & Allegheny R. R. Co. succeeded Canal Co. and scaled down these bonds to $3,305.83, making payment to city. Aug. 5, '81, latter Co. guaranteed city one-fifth entire flow of James river at this point, min. flow being estimated at 1,000 cu. ft. a second, or 646,272,000 ft. a day, which gives city an est. available dy. supply of about 129,000,000 galls. for consumption and use in pumping.

Dam.—Across James river to form impounding reservoir and give water-power for pumping; built at lower end of Daniel's island, a series of dams above connects Jones & Woodroof's island with opposite shore. It is not stated whether this dam has been rebuilt since '28.

Pumping Machinery.—Dy. cap., 7,800,000 galls.

In '28 a breast-wheel 19 ft. in diam. and 9½ ft. wide, and a 10 x 48-in. pump were erected, and forced water through a 7-in. cast-iron pipe. In '68 a 60-in. Reynolds turbine and a 12 x 60-in. pump were put in. This pump was designed by A. Forsberg.

In '79 R. D. Wood & Co. began construction of two vertical plunger and bucket pumps, which are operated by a Jonval turbine, and so arranged that during freshets power can be supplied from a horizontal 20 x 30-in steam engine, driven by two 50 H. P. tubular boilers. This pump has a dy. cap. of 1,500,000 gal s., lifting 330 ft. through 4,400 ft. of pipe to high-service reservoir.

June, '81, old breast-wheel and pump, constructed in '28, were removed to give room for forebay to new works, and 18 x 12 x 18-in. Knowles steam pump was erected, pumping about 700,000 a day through the 7-in. main to the low service reservoir.

Latter part '81 piston pump constructed in '68 was repaired and supplied with a new turbine, and purchase of a 2,000,000-gall. duplex double plunger pump was authorized. Plunger pattern was adopted because the water is gritty.

In '89 3,000,000 Gaskill water-power pump was added.

Low Service Reservoir.—Cap., 4,000,000 galls.; two equal compartments, ½ mile from and 255 ft. above river. This is an enlargement of old reservoir, built in '28, which originally had a cap. of 500,000 galls., depth of 10 ft., was in excavation and embankment, with bottom paved with brick in cem. and its sides with cobble stones. Bottom of old reservoir leaked for many years. Drain-pipe was placed 1 ft. above bottom, increasing labor of cleaning out sediment, which was deposited at the rate of 4 ins. a year.

High Service Reservoir.—Cap., 4,000,000 galls. Built in '77-8 with money bequeathed city by Saml. Miller in '69 on condition that it should be spent within 10 years towards "furnishing a supply of water to persons residing on the hill west of the city not now [then] supplied with the James river water." The reservoir is 4,400 ft from, and 330 ft. above the river, 232 ft. in diam. at the top, 16 ft. deep, has inner slopes of 2 to 1 lined with two courses of stone flagging in cement. Excavation was was first through 1 ft. of red clay, then 10 ft. of dark tenacious clay, in which were many sandstone boulders, then porous gravel.

The first pipes were unprotected from corrosion, and the very soft river water caused them to fill rapidly with rust. A 3-in. pipe was found in Main street in '58 with its diam. reduced nearly one-half, and so weakened by corrosion that a tap could not be made without strengthening the pipe by iron bands. A section of 4-in. pipe, in use for 48 years, and badly corroded, was contributed by A. Forsberg for exhibition by the Am. Soc. C. E. at Centennial, in '76.

Original pipes were manufactured in Philadelphia, were very hard, in 9-ft. lengths, with 4-in. hubs. The 3-in. pipe was 9-16, and the 4-in. 5/8-in. thick. They were evidently cast horizontally, and some were ¾ in. scant on one side and fully ¾ in. thick on other. Since '68 all pipes have been coated with Dr. Angus Smith's preparation, and corrosion entirely prevented.

Distribution.—*Mains*, c. i., 20 miles. *Services*, w. i. Pipe and specials from R. D. Wood & Co., Philadelphia, Pa. *Taps*, 1,300. *Meters*, 8. *Hydrants*, Bailey, about 200. *Valves*, Eddy.

Consumption, 1,500,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 120 lbs.

Financial.—Cost, "unknown," est., $350,000. Debt, about $350,000. Int., 5, 6 and 8%. An. op. exp., $9,450. Ann. rev.: consumers, $20,000; city, $5,000. Cost in '78, $50,000. Cost to '81, $171,102. Total op. exp. and repairs to '81, $51,378.

Management.—Water Com. Chairman, James I. Lee. Registrar and Clerk, Thos. W. Greene. Supt., I. P. Page. Pumping Engr., Jno. Boze.

MANCHESTER, *Chesterfield Co.* (Pop., 5,729; est., 8,000.) On James river, opposite Richmond, on ground rising gradually from river to a range of hills 110 ft. above tide. Has extensive manufacturing interests. Settled in 1769. Incorp. town in 1769, city in '74. No sewers. Has electric lights.

OLD WORKS.

History.—Built in 40 by town. Des. Engr., Jas. L. Davis.

Water Supply.—James river, pumping to reservoir, and direct in case of fire.

Dam and Canal.—Dam was of stone, 7 ft. thick, 6 ft. high, built into river to divert water to a canal 50x2,000 ft., x6 ft. deep, having fall of 15 ft., which furnished water-power to drive pump.

Pumping Machinery.—Dy. cap., about 100,000 galls.; double-acting, 8 x 36-in. water-power, plunger; made by Robert Baird. *Water-wheel*, turbine, 15 ft. head.

Reservoir.—Cap., 400,000 galls; 107x107 ft., x5 ft. deep; 110 ft. above pump. Bottom and inner slopes lined with brick in cem. Bottom has leaked, giving much trouble, and in '83 large break occurred, and bed of quicksand was found underlying clay bottom of reservoir.

Distribution.—*Mains*, c. i., 0.7 miles. *Services*, lead. *Taps*, 81. *Meters*, none. *Hydrants*, "old-fashioned," 7. *Pressure-recording gauge*, Edson.

Consumption, 80,000 galls. *Pressure*, 40 lbs.

Financial.—Cost, unknown. Debt, not given. Ann. op. exp., about $200. Ann. rev.: consumers, $750; city, none.

Management.—Under control of Chief of Police.

NOTE.—Above given in '88. Not stated whether works have been abandoned.

NEW WORKS.

History.—Built in '88-9 by Wm. H. White & Bro., 32 Wall street, N. Y. City. Provision is made for future purchase of works by city.

Water Supply.—James river, above Canoe run, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Worthington.

Stand Pipe.—No data.

Distribution.—*Mains*, c. i., 6½ miles. *Services*, not given. *Taps*, 300. *Hydrants*, kind not given, 52.

Consumption, 60,000 galls. *Pressure*, 40 lbs.

Financial.—Cost, $60,000. Debt, none. Ann. op. exp. and rev., not determined. Hydrant rental, $45. Charges to consumers not to exceed those in Richmond and Co. to be exempt from city taxation for 10 years.

Management.—Prest., Wm. H. White, 32 Pine St., N. Y. City. Secy. and Treas., C. A. White. Supt., H. S. Bradley.

MARION, *Smyth Co.* (Pop., 919; est., 1,500.) On Holston river. Engaged in mining and manufacturing. No sewers or electric lights.

History.—Built in '88 by town. Contrs., Glamorgan Iron Co., Lynchburgh.

Water Supply.—Springs in freestone rock, by gravity to stand-pipe.

Stand-Pipe.—No data.

Distribution.—*Mains*, 3½ miles. *Services*, not given. *Taps*, 90. *Meters*, not given. *Hydrants*, kind not given, 12.

Consumption, unknown. *Pressure*, 20 to 200 lbs.

Financial.—Cost, $13,000. Bonded debt, $12,000. Int., 6%. Ann. op. exp. and rev., not determined.

Management.—Council. Recorder, J. H. Gallehan.

NATIONAL SOLDIERS' HOME, *Hampton, Elizabeth City Co.* (Pop., 2,900.) See Hampton.

NORFOLK, *Norfolk Co.* (Pop., 21,966; est., 30,000.) On Elizabeth river, on arm of Chesapeake bay, 32 miles from ocean, on low, flat ground. Has good harbor. Engaged in foreign and domestic commerce and manufacturing. Founded in 1705; incorp. borough in 1736; city in '45. Has sewers and electric lights.

History.—Built in '72 by city. Engr., Robt. K. Manning.

Water Supply.—First Moore's Bridges, Lakes Lawson and Bradford, by direct pumping.

Tests were made in '88 of gang-well and other systems with a view of increasing and improving supply, which is not only limited, but also has an unpleasant odor, taste and color, in common with all surface water found in tide-water regions in Va.

Moore's Bridges Dams and Reservoir.—Cap., 40,000,000 galls. Two dams, earth, with puddle heart-walls. Heart-walls and waste-weir to first dam, built in '74. *Settling Basin:* at this reservoir. No data.

Lake Bradford: No data.

Lake Lawson: cap., 120,000,000 galls.; area '85 acres. In '85 lake was pumped dry. Water is pumped to elevation 8 ft., then flows to Moore's Bridges reservoir, 2¼ miles distant.

Suction-pipe and conduit to Moore's Bridges reservoir: diam. of suction-pipe not given; extends 70 ft. into lake on floating framework of oak and cypress timber. Water was first pumped into wooden conduit, 12 x 18 ins., but in '78 this showed signs of decay, and was partially replaced by 20-in. c. i. pipe.

Pumping Machinery.—*Main Station:* dy. cap., 10,000,000 galls.; 5,000,000 Gaskill horizontal comp., cond., dup., bought in '86; 1,000,000 high-pressure Worthington, bought in '73; two 2,000,000 comp. Worthington, bought in '80. Small Worthington, not used in '87-8, and other Worthingtons only when Gaskill is stopped for repairs. A 2,000,000 Holly quadruplex was formerly in use.

Lake Lawson Station: dy. cap., 4,000,000 galls.; 2,000,000 Worthington, 2,000,000 Deane high-pressure, the first bought in '80 and the second in '87. There is an independent condenser for the two pumps.

Bradford Station: dy. cap., 2,000,000 galls.: Gaskill horizontal high-pressure pump bought in '84.

Aerating Plant.—Dy. cap., 3,000,000 galls.; National; placed at main station at Moore's Bridges, in '88. Originally had an 8 x 12-in. Ingersoll compressor, which has been replaced by one 12 x 18 ins., as at 60 revolutions a minute consumption of coal was one-half that of the 5,000,000-gall. engine when pumping 3,000,000-galls. a day, while speed necessary to work plant to its full cap. was 130 revolutions a minute.

Distribution.—*Mains*, c. i., about 32 miles. *Services*, w. i., lead. *Taps*, 4,177. *Meters*, 85. *Hydrants*, Mathews, 126. *Gates*, Whittier.

Consumption, 3,000,000 galls. *Pressure:* Ordinary, 30 lbs. Fire, 99 lbs.

Financial.—Cost, $837,000. Debt, $640,000: $500,000 at 8, $140,000 at 5%. Ann. op. exp., $18,155. Ann. rev., $55,278.

Management.—Three Comrs. Secy., D. S. Burwell. Supt. R. Y. Zachery. Registrar, Jno. R. Todd.

PETERSBURGH, *Dinwiddie Co.* (Pop., 21,656; est., 25,000.) On Appomattox river, on three terraces rising from water. Has harbor for light draught vessels. Settled in 1686; incorp. city in '50.

History.—Built in '56 by city. Engr., Henry D. Bird.

Water Supply.—Small brook, pumping from impounding to distributing reservoir.

Dam and Impounding Reservoir.—Cap., 2,664,000 galls. Dam, of stone, 40 ft. high, 40 ft. high at bottom, 5 at top.

Pumping Machinery.—Dy. cap., 750,000 galls.; Guild & Garrison. Formerly in use a 13 x 60-in. pump made by Uriah Wells, Pittsburgh.

Distributing Reservoir.—Cap., 2,675,575 galls. First distributing reservoir was 100 ft. above pump, had cap. of 300,000 galls., and was in excavation and embankment, lined with brick.

Distribution.—(In '87.) *Mains*, c. i., 11 miles. *Services*, galv. i., lead. *Taps*, 1,080. *Meters*, none. *Hydrants*, Starr, Mathews, 110. *Valves*, Pect, Eddy.

Consumption (in '87), 750,000 galls. *Pressure:* Ordinary, 24 lbs. Fire, 60 lbs.

Financial.—(In '87.) Cost, $150,000. Debt, $125,000. Int., 8%. Ann. op. exp., $9,000. Ann. rev.: consumers, $12,000; city none.

Management.—(In '88.) Com. of three. Supt., J. S. Cooke. Pumping Engr., C. W. Davis.

NOTE.—No reply to inquiries sent in '89.

PORTSMOUTH, *Norfolk Co.* (Pop., 11,390.) On Elizabeth river, opposite Norfolk. Has railroad shops, manufactories and Government Navy Yard. Incorp. No sewers. Has electric lights.

History.—Construction begun in '83 by Portsmouth Water Co., and abandoned from '85 to '87, when it was taken up by Portsmouth & Suffolk Water Co., and finished in '87-8.

Original plan, as proposed by D. McN. Stauffer, N. Y. City, was to pump temporary supply from Deep creek, 5 miles distant, to a tank, at an elevation of 25 ft., from which it would flow by gravity to large pump-well near town. Here larger pumps would force water through distribution system, and across the Elizabeth river to Norfolk, also supplying Berkeley.

Owing to delay the Co. lost its concessions for carrying out the above plan, but was afterward granted new concessions for a supply from Kilby's lake, 18 miles distant, and had works well under way with Jno. F. Ward, Jersey City, as Sub-contr., when they were abandoned in '85. In '87 works were bought by C. D. Ward for a committee of holders of first mortgage bonds.

In '87-8 works were finished by Portsmouth & Suffolk Water Co. Des. Engr., Wm. E. Worthen. Const. Engr., Jos. Hastings. Contr., Jno. McNamee, Brooklyn.

Suffolk was supplied from this system in '89. It is close by the pumping station at Kilby's lake.

Water Supply.—Kilby's lake, pumping through stand-pipe, near by, to reservoir at Portsmouth; thence pumped directly to mains.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; Gordon & Maxwell, two Davis. A 2,000,000 Davidson and 1,000,000 Gaskill water-power are reported by manufacturers.

Stand-Pipe.—Cap., 100,000 galls.

Supply Main.—Principally 14-in. spiral w. i., 18 miles long; laid along right of way of Seaboard & Roanoke R. R.

Distribution.—*Mains*, 30½ miles, including supply main: distributing, c. i. *Services*, w. i. Pipe and specials from R. D. Wood & Co., Philadelphia, Pa. *Taps*, 124. *Meters*, 4. *Hydrants*, Chapman, 100. *Valves*, Chapman.

Consumption, 300,000 galls. *Pressure*, not given.

Financial.—Cost, withheld, est., $225,000. Debt, $175,000. Int., 6 . Ann. op. exp., $9,000. Ann. rev.: consumers, $6,000; city, $7,500. Hydrant rental, $75. It is unofficially reported that the incomplete works were bought in '87 for $81,500.

Management.—Prest., Jno. R. Planter, N. Y. City. Supt., G. H. Coleman.

RADFORD, *Montgomery Co.* (Pop., est., 2,000.)

NOTE.—Mar. 1, '90, Howard Murphy, Philadelphia, Pa., reported that he was designing and constructing works.

RICHMOND, *Henrico Co.* (Pop., 63,600; est., 85,000.) On James river at head of tide water, 151 miles from its mouth. Good water-power. City is built on cluster of hills. Engaged in commerce and manufacturing. Settled in 1609. Has sewers and electric lights

History.—Built in '30 by city when pop. was 16,060. Engr., Albert Stein. In '82 new pumping station was added, largely increasing supply.

Water Supply.—James river, pumping to low and high service reservoirs.

Pumping Machinery.—Dy. cap., 24,000,000 galls. Old pumping station near city limits, new, about 2 miles distant. Nearly all pumping is done by water-power.

Old Station.—Dy. cap., 6,000,000 galls. First pump in '30 was a horizontal double-acting 10x72-in. piston pump, driven by a 16-ft. breast wheel, 10 ft. wide. It lifted water to a reservoir 166 ft. above river through 2,400 ft. of 8-in. pipe. In '34 a wheel and pump of same size were added, and in '54 two more pumps were placed, 12x72 ins., also driven by breast wheels. In '73 a Jonval turbine, 9 ft. in diam., working under 10 ft. head, and two horizontal double-acting 17x72-in. pumps were added. These forced water into a new reservoir, 203 ft. above river. As an auxiliary a Guild & Garrison steam pump, 12x32 ins., was used to lift water from the James river and Kanawha canal, it being placed 43 ft above the main station. This has not been used since '82.

New Station.—Dy. cap., 18,000,000 galls. There are three "partial turbines," working under 20 ft. head, driving 9 pumps with a dy. cap. of 12,000,000 galls., and a 6,000,000 gall. Worthington steam pump. Wheels and water-power pumps designed by Prof. Chas. Smith, St. Louis, Mo., and built by H. A. Ramsay, Baltimore, Md. Water for power and supply is taken from a conduit leading from James River. Const. Engr. for station, W. E. Cutshaw, City Engr.; Asst., Chas. E. Bolling, Supt.

Force Mains.—Old pump-house to Marshall reservoir, 7 mains, each 2,500 ft. long, Nos. and 2, 12 in., Nos. 3 to 6, 8-in; from new station to new reservoir, 30-in., 4,000 ft. long.

Reservoirs.—Cap., 49,300,000 galls. *Marshall Low Service:* cap., 9,300,000 galls.; water-surface, 256 x 382 ft.; depth, 15 ft.; 166 ft. above pumps. In clay embankments 8 ft. wide at top, about 53 at bottom. Slopes, 1½ to 1, inner lined with brick on edge laid diagonally; outer slopes, turfed. Bottom paved with brick laid flat in lime mortar. No gate-houses. Built in '30. Engr., Albert Stein. Originally 10.7 ft. deep, in two compartments, with gravel filter-bed in one; apparently latter did not work well. In '43 embankments were raised 6 ft. and addition made. In '85 division wall was removed, as also 4 ft. of sediment from bottom.

High Service: cap., 40,000,000 galls.; in two equal compartments, each with water surface 416 x 426 ft.; depth, 23 ft. Settling space between bottom of discharge-pipes and bottom. Main banks of puddled clay, 20 ft. wide at top, 104 at bottom, with inner slopes, 2 to 1, outer 1½ to 1, turfed. Division bank of puddled clay, 16 ft. wide on top, 88 at bottom, slopes, 1½ to 1. All inner slopes paved with brick on edge in cem. Stone coping for each slope. Bottom covered with 6 ins. of concrete. *Influent and Effluent Chambers and Pipes:* chambers in division bank, at either end, on line inner slope main banks; discharge to either compartment or both. Two 30-in. influent, do., outlet pipes; also two 12-in. supplementary effluent pipes, one leading directly from each compartment. Vault for both influent and effluent pipes, just outside banks. Built in '74. Engr., W. E. Cutshaw, City Engr., Asst. Engr., Chas. E. Bolling, Supt. (See References below.)

Supply Mains.—From Marshall reservoir, 10 and a 12-in., each 1,539 ft. long, both connecting with 20-in. main at Linden St.; also (not in use) 16-in., 800 ft. From new reservoir, 30-in., 7,103 ft. long. Also 24-in., 9,700 ft. long, formerly force main from old pumps to both reservoirs, now used between new reservoir and city for supply.

Distribution.—*Mains*, c. i., 78.21 miles, including force and supply mains. *Services*, lead. *Taps*, 9,606. *Meters*, 85. *Hydrants*, Ludlow, Tanner & Delaney, 475.

Consumption, 11,311,013 galls. *Pressure*, 41 lbs.

Financial.—Cost, unknown, but est. value is $1,500,000. Debt and int., not given. Ann. op. exp., $36,222. Ann. rev.: consumers, $116,999.

Management.—Water Com. of 7. Chn., J. C. Dickerson. Supt., C. E. Bolling.

References.—"Description of the Water Works at Richmond, Va." By C. E. Bolling, Supt., Richmond, Va. E. Waddey, City Printer. Same, Journal N. E. W. W. Assn., Sept., '89. Complete historical and general description, '32 to '89.

ROANOKE, *Roanoke Co.* (Pop., est., 10,000.) In agricultural and mining region. Has tobacco factories, car shops, iron and locomotive works. Incorp. Partly sewered. Has electric lights.

History.—Built in '84 by Roanoke Land & Improvement Co. July 1, '89, Co. consolidated with Roanoke Gas Co., under name of Roanoke Gas & Water Co. Extensions made with Howard Murphy, Philadelphia, Pa., Engr.

Water Supply.—Spring on Mill mountain, pumping to reservoir, with direct pumping when necessary. Pumping direct and to tank was used until '88 but tanks have been abandoned.

Pumping Machinery.—Dy. cap., 3,500,000 galls.; 2,000,000 Gaskill dup., 1,500,000 Worthington. *Boilers:* Holly. A 2,000,000 Gaskill dup. contracted for in '89.

Reservoirs.—Cap., about 2,500,000 galls.; in two compartments, on Mill mountain, 195 ft. above spring, 232 above city. Serious break in bottom of reservoir in '88, owing to limestone cavities beneath. Bottom has been successfully repaired. Built in '87-8. Engr., see History. Labor done by the day.

Distribution.—*Mains*, 4 to 16-in. c. i., 15 miles. *Services*, galv. i. *Taps* (in '87) 1,157. *Meters*, none. *Hydrants*, Mathews, Cassin, 50. *Valves*, Eddy, Cassin.

Consumption, 1,350,000 galls. *Pressure*, 125 lbs.

Financial.—(In '87.) Cost, $250,000. Cap. stock, $250,000. No debt. Ann. op. exp., $5,000. Ann. rev.: consumers, $16,000; city, $1,200. Hydrant rental, $25.

Management.—Prest., F. T. Kimball, Philadelphia. Secy. and Treas., H. E. Gerhard, Philadelphia. Supt., F. T. Brinkley.

SALEM, *Roanoke Co.* (Pop., 1,759; est., 2,300.) Near Roanoke river in valley on spur of Blue Ridge. Has some manufactories. Incorp. town in '32. No sewers or electric lights.

History.—Built in '75-6 by town after plans by L. Morrison.

Water Supply.—Springs, pumping to reservoir.

Pumping Machinery.—Dy. cap., 60,000 galls; Guild double-acting water-power.

Reservoir.—Cap., 250,000 galls.; 185 ft above town, excavated in clay, lined with brick in cem.

Distribution.—*Mains*, c. i., 6 miles. *Services*, w. i. *Taps*, 250. *Meters*, none. *Hydrants*, kind not given, 33.

Consumption, 40,000 gails. *Pressure*, 185 ft. head.

Financial.—Cost (in '87), $12,718. Bonded debt, $10,500. Int., 6%. Ann. op. exp., $300. Ann. rev.: consumers, $1,500.

Management.—Town Council. Secy. and Treas., T. R. Boon. Supt., J. B. Boon

SOUTH BOSTON, *Halifax Co.* (Pop., est., 1,500.) Tobacco market. Incorp. town. No sewers. Has electric lights.

History.—Built in '88-9 by town for fire protection. Engr., C. A. Ballou, Danville. Contrs., Glamorgan Co., Lynchburgh. **Water Supply.**—River Dan, pumping to stand-pipe. **Pumping Machinery.**—Dy. cap., 300,000 galls.; Worthington. **Stand Pipe.**—Cap., 63,000 galls.; 12 x 75 ft. **Distribution.**—*Mains*, 8 to 6-in. c. i., 1¼ miles. *Hydrants*, Ludlow 14. *Valves*, Ludlow. *Pressure:* Ordinary, 60 lbs. Fire, 80 lbs. **Financial.**—Cost, $15,000. Debt., $15,000. Int., 6%. **Management.**—Chn. Com., W. D. Barbour.

STAUNTON, *Augusta Co.* (Pop., 6,664; est., 7,000.) On elevated plateau in Blue Ridge, about 1,450 ft. above sea. Ground slopes 25 ft. to mile. Engaged in manufacturing. Settled before 1738; incorp. city in '71.

History.—Built in '76-7. Engr., Donald Allan. Contrs., Menefee & Parkins, Staunton. Sub-contrs.: masonry, McMahon & Keefe; brick-work of buildings Jordan & Shumate; wood-work, W. T. Marr.

Water Supply.—Ten springs in limestone, pumping from receiving to distributing reservoir.

Collecting Conduits.—About 2 miles of 4 to 16-in. stoneware pipe laid in cem.

Receiving Reservoir.—No data.

Pumping Machinery.—Dy. cap., not given; 1,250,000-gall., Worthington comp., dup., Deane.

Reservoir.—Cap., 2,500,000 galls.; 210 ft. in diam. at top, 183 at bottom; 182.6 ft. above pumps.

Distribution.—(In '87.) *Mains*, 12 to 4-in. c. i., 13 miles. *Services*, w. i. Pipe and specials from Tredegar Co., Richmond. *Taps*, about 1,200. *Meters*, 2. *Hydrants*, kind not given, about 50.

Consumption, 880,000 galls. *Pressure*, Fire, 110 lbs.

Financial.—(In '87.) Cost., $100,000. Debt, $80,000. Int., 8%. Ann. op. exp. $2,500. Ann. rev.: total, $10,000.

Management.—Water Com. of three. Supt. (in '88), Jno. T. Long.

NOTE.—No reply to inquiries sent in '89.

SUFFOLK, *Nansemond Co.* (Pop., est., 2,500.) On Nansemond river, 17 miles from Portsmouth and 2 miles from Kilby's lake, the source of the Portsmouth water supply.

History.—Built in '89 by Nansemond Water Co., and operated by Portsmouth & Suffolk Water Co., being on their force-main; put in operation May 14. Des. Engr., L. B. Ward. Const. Engr., C. D. Ward.

Water Supply.—Portsmouth water-works.

Distribution.—*Mains*, c. i., 5 miles. *Meters*, Crown, number not given. *Hydrants*, 35. *Valves*, Chapman.

Pressure: Ordinary, 25 lbs. Fire, 43 lbs.

Financial.—Cost, withheld. Cap. stock, $10,000. Bonds, $75,000. Hydrant rental, $75.

Management.—Supt., George H. Coleman, Portsmouth.

TAZEWELL, *Tazewell Co.* (Pop., est., 900.) Near head waters of Clinch river in agricultural and grazing district. Incorp. town. No sewers or electric lights.

History.—Built in '86-8 by village. Const. Engr., Jas Allen, Lynchburg.

Water Supply.—Spring, by gravity. Spring about 1¼ miles from the village, and 320 ft. above the court-house. A 2-in. pipe, 2,745 ft. long, conducts water to reservoir.

Reservoir.—Cap., 35,000 galls. Is of stone masonry, 26 ft. in diam. at top, 22 ft. at bottom, 11 ft. deep, and 170 ft. above town. A 4-in. c. i. main extends from reservoir to town, and through Main St. Cost, $780. Contr., D. J. Phipps, Tazewell.

Distribution.—*Mains*, 4-in. c. i., 1.3 miles. *Services*, ¾-in. w. i. Pipe and specials from Glamorgan Co., Lynchburgh. Trenching done by W. S. Brown and Geo. Foss, Tazewell, and pipe-laying superintended by Jas. Allen. *Taps*, 20. *Meters*, none. *Hydrants*, Galvin, 7; also 5 service hydrants made by Jarecki, Hayes & Co. Erie, Pa

Consumption, not determined. *Pressure*, not given.

Financial.—Cost, $5,000. Debt, $4,000. Int., 6%. Ann. op. exp., $150. Ann. rev.: consumers, $350.

Management.—Supt., G. L. McClintock.

UNIVERSITY OF VIRGINIA, *Albemarle Co.* (Pop., 650.) Near Charlottesville. Founded in '26.

History.—Built in '58, and new works built in '68. Engr. for first, Chas. Ellett; for second, G. Peyton. In '86 University and City of Charlottesville built reservoir 5 miles from University, and laid pipe to connect with former distribution. University paid about $25,000 for its part of work.

Former supply was from reservoir in mountains, two miles distant, which was filled by springs and surface water. A dam 20 ft. high and 100 ft. long on top was built across a ravine. It consisted of two walls of brick in cem. mortar, 6 ins. apart, filled between with beton. Cap., $2,000,000 galls.; 70 to 100 ft. above University grounds. A 5-in. c. i. main extended one mile from reservoir to grounds. Before '68 a No. 5 Worthington pump lifted water to tanks of 30,000 galls. cap., placed 60 ft. above highest grounds. Tanks were retained.

See Charlottsville for description of Water Supply and Reservoir.

Distribution.—Arranged to supply University grounds and buildings. *Taps*, about 60. *Pressure*, about 100 lbs.

Financial.—Cost (in '81), $28,182; improvements in '86, $25,000. Ann. op. exp. $125. No rev. Cost in '60, $17,675; '80, $25,480.

Management.—Supt., G. Peyton.

WINCHESTER, *Frederick Co.* (Pop., 4,958; est., 5,000.) On broken ground in Shenandoah valley, 33 miles from Washington. Has paper, sumach and flouring mills, foundries and shoe and glove factories. Settled in 1752; incorp. in 1779.

History.—Built in '81 by town.

Water Supply.—Spring, ¼ mile from and 50 ft. above village, by gravity.

Distribution.—(In '87.) *Mains*, c. i., 8 miles. *Services*, not given. *Taps*, about 550. *Meters*, none. *Hydrants*, kind not given, 50.

Consumption and *Pressure*, not given.

Financial.—Cost, withheld, est., $100,000. Debt and int., not given. Ann. op. exp. (in '87), $500. Ann. rev. (year ending May 1, '82). $3,000.

Management.—Supt., Jno. H. Nulton.

NOTE.—No reply to inquiries sent in '89.

WYTHEVILLE, *Wythe Co.* (Pop., 1,885; est., 3,000.) Has manufactories. Incorp. town. No sewers or electric lights.

COMPANY'S WORKS.

General Description.—Built in '38. Supply, gravity, to and from reservoir. *Mains*, 4-in. c. i., 3 miles. *Hydrants*, 8. *Pressure*, 30 lbs. No debt.

PRESENT WORKS.

History.—Built in '89 by city; put in operation Sept. 1. Engr., R. Taylor Gleaves. Contrs., Glamorgan Co. Both of Lynchburgh.

Water Supply.—Large spring, pumping from storage to high service reservoir.

Storage Reservoir.—No data.

Pumping Machinery.—Dy. cap., 750,000 galls.; Worthington.

High Service Reservoir.—Cap., 1,000,000 galls.

Distribution.—*Mains*, 6 and 4-in. c. i., 3 miles. *Meters*, none. *Hydrants* Mathews, 21. *Valves*, Eddy.

Pressure: Ordinary, 60 lbs. Fire, 90 lbs.

Financial.—Cost, $20,000. Debt, $21,000. Int., 6%.

Management.—Mayor, C. W. Gleaves. Supt., A. C. Clark. Latest report, Sept. 24, '89.

Water-Works Projected with Fair Prospects of Construction.

PULASKI CITY, *Pulaski Co.* (Pop., est., 2,000.) In timber, coal and zinc district.

Proposed Works.—Dec., '89, Geo. W. Dudley reported that works were projected by town. For former project, see MANUAL for '88, p. 257.

Water-Works Projects Reported in '89 and '90, but Now Indefinite.

Bon Air, Chesterfield Co. *Farmville*, Prince Edward Co.: see MANUAL for '88, p. 286. *Franklin*, Southampton Co

---

WEST VIRGINIA.

Water-Works Completed or in Process of Construction.

BLUEFIELD, *Mercer Co.* (Pop., est., 2,000.) Incorp. town. No sewers. Has electric lights.

History.—Built in '88 by Norfolk & Western R. R. Co.; known locally as Bluefield Water Co.; put in operation in Aug. Des. Engr., W. W. Coe. Const. Engrs., H. C. Macklin, Roanoke, Va., and N. L. Reynolds, Bluefield Contrs., Glamorgan Co., Lynchburgh, Va.

Water Supply.—Springs, by gravity.

Tank.—Cap., 50,000 galls.

Distribution.—*Mains*, 6 to 3-in. c. i., 3 miles. *Services*, ¾-in., material not given, *Taps*, withheld. *Hydrants*, none. *Valves*, Chapman.

Consumption, 80,000 galls. *Pressure*, 80 lbs.

Financial.—Cost, $13,000.

Management.—Supt., Malcolm W. Bryan.

CHARLESTON, *Kanawha Co.* (Pop., 4,192; est., 8,000.) On Great Kanawha and Elk rivers, on slightly undulating ground. Great Kanawha river is navigable for 25 miles above city. In coal and iron region. Incorp. Partially sewered. Has electric lights.

History.—Built in '85-6 by Charleston Water-Works Co., under 20-years franchise. Engr., E. R. Davenport. Site for reservoir bought in '89.

Water Supply.—Elk river, by direct pumping, water being admitted through inlet pipe to suction basin, and pumped through filter to city when water is muddy. River is a mountain stream, generally clear.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two 1,500,000 Deane, 14 and 20 x 18-in. cylinders, 12-in. pump. *Boilers:* two Ward.

Filter.—Dy. cap., 500,000 galls.; Hyatt.

Distribution.—*Mains*, 4 to 16-in. kal. i., 14 miles. *Services*, kal. i. *Taps*, 850. *Meters*, 1. *Hydrants*, Ludlow. *Valves*, Ludlow. *Pressure-recording gauge*, Edson.

Consumption, 500,000 galls. *Pressure:* Ordinary, 40 to 45 lbs. Fire, 80 lbs.

Financial.—Cost, $126,500. Cap. stock, $42,000. Bonded debt, $84,500. Int., 6%. Ann. op. exp., $5,000. Ann. rev.: consumers, $11,300; city, $2,500. Hydrant rental, $50; 10 free for first 5 years.

Management.—Prest., E. B. Knight. Secy., W. S. Laidley. Supt. and Treas., Frank Woodman.

CLARKSBURGH, *Harrison Co.* (Pop., 2,037; est., 8,000.) In Clark and Coal townships, in coal region. Has manufactories.

History.—Built in '88 by town. Engr., Jno. W. Hill, Cincinnati, O.

Water Supply.—West fork of Monongahela river, pumping to tanks.

Pumping Machinery.—Dy. cap., 500,000 galls.; two comp., dup., direct-acting Deane.

Tanks.—Cap., 560,000 galls.; two 280,000 gall. steel tanks, 40 x 30 ft.; 340 ft. above pumps; from Cox & Morrison, Wheeling.

Distribution.—*Mains*, c. i., 6½ miles. Pipe and specials from R. D. Wood & Co., Philadelphia, Pa.; trenching and pipe-laying done by R. B. Carothers, Newport, Ky. *Hydrants*, Bourbon, 51. *Valves*, Eddy.

Pressure, 80 lbs.

Financial.—Cost $50,000. Bonded debt, $50,000. Int., 5%. Ann. op. exp. and rev., not determined.

Management.—Three Comrs. Supt., W. R. Alexander.

GUYANDOTTE, *Cabell Co.* (Pop., 819; est., 1,200.) On Guyandotte river, joining Huntington.

History.—Built in '88 by Guyandotte Water Co., and managed by American Water-Works & Guarantee Co., Ltd., Pittsburgh, Pa. Extension of Huntington works.

Water Supply.—Huntington works, through reservoir.

Reservoir.—Cap., 2,000,000 galls.

Distribution.—*Mains*, c. i., 4 miles. *Taps*, withheld: est., 150.

Financial.—Cost, withheld, est., $35,000. Cap. stock, $50,000. Bonds, $25,000. Int., 6%. Ann. op. exp. and rev., not determined.

NOTE.—No reply to inquiries sent in '89. See Huntington

HUNTINGTON, *Cabell Co.* (Pop. 3,174; est., 8,000.) On Ohio river. Has large car and other manufacteries, and extensive shipping business.

History.—Built in '87 by Huntington Water Co., and managed by American Water-Works & Guarantee Co., Ltd., Pittsburgh, Pa. Supplies water to Guyandotte.

Water Supply.—Ohio river, filtered, by direct pumping.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; Worthington. *Boilers:* two 60-H. P.; from Jno. O'Brien Boiler Works Co., St. Louis, Mo.

Filter.—Dy. cap., 400,000 galls.; National.

Distribution.—(In '87.) *Mains*, c. i., 8½ miles. *Services*, galv. i. Pipe and specials from Addyston Pipe & Steel Co., Cincinnati, O. *Taps*, 326. *Meters*, not given. *Hydrants*, Ludlow, 84. *Valves*, Ludlow.

Consumption, 300,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 90 lbs.

Financial.—Cost, $90,000. Cap. stock, $100,000. Bonds, $75,000. Int., 6%. Ann. op. exp., withheld, est., $2,500. Ann. rev., withheld, est., $6,000.

Management.—(In '88.) Genl. Mgr., Wm. S. Kuhn, Pittsburgh, Pa. Supt., W. W. Cunningham.

NOTE.—No reply to inquiries sent in '89.

MARTINSBURGH, *Berkeley Co.* (Pop., 6,335; est., 7,500.) On small tributary of Potomac river, in rolling country. Has railroad repair shops, distillery, spoke works and lime and phosphate factories. Laid out in 1732. Incorp. Partly sewered. No electric lights.

History.—Built in '73-4 by city. Contrs., Denison & Cowell, Muscatine, Iowa.

Water Supply.—Springs, by direct pumping.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; 4 Holly water-power, 7½ x 22 ins., with supplemental steam pumps and rotary pump. *Boilers:* two horizontal tubular, 5x16 ft.

Distribution.—*Mains*, w. i. and cem., 7½ miles. *Services*, w. i. *Taps*, 700. *Meters*, none. *Hydrants*, Holly, 54. *Valves*, Ludlow.

Consumption, 300,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 80 lbs.

Financial.—Cost, $100,000. Debt, $80,000. Int., 5%. Ann. op. exp., $1,500. Ann. rev.: consumers, $3,500; city, none.

Management.—Water Board of 5 from City Council. City Clerk, C. H. Young. Supt., J. M. Schaffer.

MORGANTOWN, *Monongalia Co.* (Pop., 745; est., 1,500.) On Monongahela river. Has manufactories. Incorp. city. No sewers or electric lights.

History. Built in '89 by Union Improvement Co.; put in operation Sept. 10. Engr., M. Grant. Supt. Labor by the day. Co. also owns gas works.

Water Supply.—Mountain stream, by gravity.

Reservoir.—Cap., 400,000 galls.

Distribution.—*Mains*, 6 and 4-in. c. i., 8 miles. *Services*, lead. *Hydrants*, Ludlow. *Pressure*, 100 lbs.

Financial.—Cost, $35,000 to $40,000. Cap. stock, including that of gas works, $100,000. Hydrant rental, $40.

Management.—Prest., Jas. W. Rowland. Secy. and Treas., A. M. Comstock. Both of Emlenton, Pa. Supt.: E. M. Grant. Latest report, Sept. 7, '89.

PARKERSBURGH, *Wood Co.* (Pop., 6,582; est., 10,000.) On Ohio and Little Kanawha rivers. Has two lines of pipe to oil region, oil refineries, foundries and machine shops, lumber and flour mills, and is a general shipping center. Incorp. Has sewers and electric lights.

History.—Built in '85 by city. Engr., Jno. W. Hill, Cincinnati, O. Contr. for masonry, M. Rush; buildings, Herman Fouse.

Water Supply.—Ohio river, pumping to tanks.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Wilson, Snyder & Co.

Tanks.—Cap., 2,000,000 galls.; two 1,000,000 iron tanks, from Riter & Conley, Pittsburgh, Pa.

Distribution.—*Mains*, c. i., 13 miles. *Services*, lead. Pipe and specials from Cincinnati & Newport Iron & Pipe Co., Newport, Ky.; trenching and pipe-laying by W. N. Ayres. *Taps*, 815. *Meters*, 4. *Hydrants*, Ludlow, 63. *Valves*, Ludlow.

Consumption, 265,000 galls. *Pressure:* At pump, 72 to 96 lbs. Fire, 68 to 90 lbs.

Financial.—Cost, $107,000. Bonded debt, $80,000. Int., 6%. Sinking fund, $14,515. Ann. op. exp., $4,000. Ann. rev.: consumers, $11,649. City advanced $26,500 in cash, without int., and this offsets sum usually paid for hydrant rental.

Management.—Secy., L. W. Hughes. Supt., Chas. F. Bryan.

WELLSBURGH, *Brooke Co.* (Pop., 1,815; est., 3,000.) On Ohio river, 16 miles from Wheeling. Incorp. Partially sewered. No electric lights.

History.—Built in '86 by town. Des. Engr., B. W. Peterson, Wheeling. Const. Engr., D. McClelland, Wellsburgh. Contr. for masonry, Jos. Gaus, Wellsburgh; for buildings, W. B. Peterson, Wheeling. In '89 extensions were projected to supply two adjoining villages.

Water Supply.—Ohio river, pumping to reservoir and direct.

Pumping Machinery.—Dy. cap., 1,800,000 galls.; two Knowles comp., dup.; last one added in '89, 12x18-in. steam, 10½-in. water cylinders. *Boilers:* tubular, from Cox & Morrison, Wheeling

Reservoir.—Cap., 230,000 galls.; 65 ft. sq. at top, 45 at bottom, 10 ft. deep; excavated in shale, puddled, paved with 3 courses brick in Rosendale cem. *Discharge-pipe:* 10-in. Built in '87. Engrs., see History. Contr., W. T. Nichols & Co., Wellsburgh.

Distribution.—*Mains*, c. i., 5 miles. *Services*, lead. Pipe and specials from Dennis Long & Co., Louisville Ky.; trenching and pipe-laying done by Redman & Bro., Wellsburgh. *Taps*, 250. *Meters*, none. *Hydrants*, Mathews, 23. *Valves*, Eddy.

Consumption, 100,000 galls. *Pressure*, 100 lbs.

Financial.—Cost, $26,000. Bonded debt, $25,000. Int., 6%. Ann. op. exp., $1,000. Ann. rev.: consumers, $2,200.

Management.—Prest., J. E. Montgomery. Secy., C. K. Scott. Supt., Nath. Nelson.

WHEELING, *Ohio Co.* (Pop., 30,737; est., 35,000.) On east bank of Ohio river and Zanes island in river, on bottom land where Wheeling creek empties into river. Hills rise on east from 250 to 600 ft. Has steel, iron, nail, pottery and flint glass and other manufactories. In bituminous coal and natural gas region, latter being used for fuel. Settled in 1782; incorp. city in '36.

History.—Built in '31-4 by town.

Water Supply.—Ohio river, pumping to reservoir.

Suction Pipes.—First were laid 100 ft. into river and perforated near ends with 1-in. holes.

Pumping Machinery.—Dy. cap., 11,000,000 galls. In '82 pumping machinery consisted of two side-lever engines, 20x84-in. cylinders, 16x120-in. double-acting pumps; engine makes two strokes to one of pump. Also 3,000,000 Worthington dup., high-pressure, 29x36-in. steam, 15-in. water cylinders. In '83 new pumping station was built, and two 2,000,000 Gordon & Maxwell double-acting vertical pumps added.

Reservoirs.—*Old:* cap., 880,000 galls.; on rock with solid masonry walls. Is 190 ft. above pumps, 150 ft. above lowest part of town, but from 25 to 50 ft. below many residences on the hill. Every year from 18 to 24 ins. of sediment is removed from its bottom.

New: cap., 3,000,000 galls. 50 x 665 ft., x 11 ½ ft. deep. Has proved a failure, water leaking out about as fast as pumped in. Built in '88-9. Contr., W. M. Chisholm, East Liverpool, O.

Distribution.—(In '87.) *Mains*, c. i., 41 miles. *Services*, lead. *Taps*, 6,900, *Meters*, none. *Hydrants*, principally Ludlow, with a few Mathews.

Consumption (in '87), 4,500,000 galls. *Pressure*, 45 lbs.

Financial.—(In '87.) Cost, $750,000. No debt. Ann. op. exp., $27,500. Ann. rev.: consumers, $58,000; city, none.

Management.—(In '88.) Water Board of four. Prest., Wm. Hastings. Secy., H. P. Wilkinson. Supt., Jas. H. Riddle.

Water-Works Projected with Fair Prospects of Construction.

WESTON, *Lewis Co.* (Pop., 1,516; est., 2,000.) On Fork River, 24 miles from Clarksburgh.

Proposed Works.—Co. to build Supply, river, pumping to reservoir. Mar. 5, '90, nothing definite had been done. Address W. J. Kitson.

Water-Works Projects Reported in '89 and '90, but now Indefinite.

Hinton, Summers Co.; see MANUAL for '88, p. 259. *Lewisburgh*, Greenbrier Co. *Moundsville*, Marshall Co. *Point Pleasant*, Mason Co. *Terra Alta*, Preston Co.

NORTH CAROLINA

Water-Works Completed or in Process of Construction.

ASHEVILLE, *Buncombe Co.* (Pop., 2,616; est., 8,000.) Is 2,500 ft. above sea, one mile from French Broad river, and two miles from Swannanoa river. Both streams are 250 ft. below town, and surrounding mountains are from 300 to 4,500 ft. above it. Has manufactories. Settled in 1795. Incorp. Has sewers and electric lights.

History.—Built in '83-7 by city. In '83 gravity system was built after plans by A. Seversedge; S. F. Venable, Const. Engr. System was afterwards extended, work being finished in '87. Des. Engr., Ernest W. Bowditch, Boston, Mass. Const. Engr., Ed. D. Bolton, Boston, Mass. Contrs. for masonry, Murdock & Colvin, Asheville.

Water Supply.—Springs and surface water, filtered, by gravity from receiving reservoir; and Swannanoa river, pumping to stand-pipe; water can be pumped to reservoir, either direct or through stand-pipe. Reservoir on side, stand-pipe on crest, pumps beyond mountain east of city.

Collecting Conduit.—For gravity supply water of each spring or stream is received in brick chamber, and brought to 6-in. earthenware pipe leading to reservoir, about 2½ miles. Brick silt chambers with blow-offs and overflow weirs were put in every 1,000 ft.

Receiving Reservoir.—Cap., 400,000 galls.; 60 ft. sq., 15 ft. deep; excavated in rock, lined with stone walls in cem.; walls on lower side, 6, others 3 ft. thick; 150 ft. above city. *Discharge-pipe:* 10-in. Leaks. Built in '83 and '86. Des. Engr., S. F. Venable. Const. Engr., T. W. Patton. Day labor.

Pumping Machinery.—Dy. cap., 1,440,000 galls.; Gordon & Maxwell water-power, 720,000 Worthington, added in '88 or '89. *Water-wheel:* turbine.

Force Main.—[Probably] 10-in.

Stand-Pipe.—Cap., 713,000 galls.; 45 x 60 ft.; steel, ⅝ and ½-in. Stone foundation. Contrs., A. Webb & Co.

Supply Main.—A 10-in. pipe from stand-pipe unites with one from reservoir, just above filters.

Filters.—Dy. cap., 650,000 galls; erected in Feb., '89.

Distribution.—*Mains*, c. i., 11 miles. *Services*, iron. Pipe and specials from Chattanooga (Tenn.) Foundry & Pipe Works; trenching and pipe-laying done by Cole & Gillett, Norfolk, Va. *Taps*, 250. *Meters*, none. *Hydrants*, Ludlow, 50. *Valves*, Ludlow.

Consumption, 300,000 galls. *Pressure:* Ordinary, 50 lbs. Fire, 100 lbs.

Financial.—Cost, about $150,000. Bonded debt, $120,000. Int., 6%. Ann. op. exp., $1,000. Ann. rev.: consumers, $3,000; city, none.

Management.—Supt., F. M. Miller.

BRYSON CITY, *Swain Co.* (Pop., est., 400.) Incorp. town. No sewers or electric lights.

General Description.—Built in '89 by town (probably) for fire protection. Gravity supply. One mile pipe. Cost, about $800. Report by E. Everett.

CHARLOTTE, *Mecklenburgh Co.* (Pop., 7,094; est., 14,000.) On Sugar creek on undulating ground. Manufactures carriages, farm implements, cotton goods, tobacco, machinery and iron castings. Settled in 1762; incorp. a city in '50. Has sewers and electric lights.

History.—Built in '81-2 by Charlotte City Water-Works Co. Des. Engr., E. S. Soper. Const. Engrs. and Contrs., Ferris & Halladay, Jersey City, N. J.

Water Supply.—Springs, pumping from impounding reservoir to stand-pipe.

Dam and Reservoir.—Cap., est., 10,000,000 galls.: 150 x 600 ft., 16 ft. deep; 120 ft. below city. Dam of clay, with timber heart-wall.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; a dup. and a high-pressure Blake.

Stand-Pipe.—Cap., 190 000 galls.; 18 x 110 ft.

Distribution.—*Mains*, 12 to 4-in. c. i., 6¼ miles. *Services*, w. i. *Taps*, 225. *Meters*, 12. *Hydrants*, kind not given, 100.

Consumption, 300,000 galls. *Pressure*, 48 lbs.

Financial.—Cost, $120,000, Cap. stock, $100,000. Bonded debt, $110,000. Int., 6%. Ann. op. exp. (in '87), $1,400. Ann. rev.: withheld, est., $6,000. Hydrant rental, $40.

Management.—Prest. A. J. Brevard. Treas., E. B. Springs. Supt. and Secy., D. P. Hutchison.

CONCORD, *Cabarrus Co.* (Pop., 1,264.)

History.—Built by individual, name and date not given.

Water Supply.—Spring, pumping to tank. Dy. cap. of spring, about 30,000 galls.

Distribution.—*Mains*, 700 ft. *Taps*, but few. *Hydrants*, 8.

Management.—Address P. B. Futze or F. A. Archible.

NOTE.—No other data.

DURHAM, *Durham Co.* (Pop., 3,014; est., 8,000.) Is 25 miles from Raleigh, and said to have most extensive tobacco factories in world. Incorp. No sewers. Has electric lights.

History.—Built in '86-7 by Durham Water Co., under exclusive franchise for 20 years. Des. Engr. and Contr., A. H. Howland. Const. Engr., Geo. A. Ellis. Both of Boston, Mass.

Water Supply.—Eno river, pumping to reservoir.

Pumping Machinery.—Dy. cap., 2,500,000 galls.; two 750,000 water-power, 1,000,000 dup. high-pressure, direct-acting Deane. *Water-wheels:* Hercules turbines. *Boiler:* from Tippett & Wood, Phillipsburgh, N. J.

Reservoir.—Cap., est., 6,000,000 galls.; 300 ft. diam., 15 ft. deep.

Distribution.—*Mains*, c. i., 14 miles. *Services*, lead. Pipe and specials from McNeal Pipe & Foundry Co., Burlington, N. J. *Taps*, 188. *Meters*, 15. *Hydrants*, Coffin, 90. *Gates*, Chapman. *Pressure-recording gauge*, Edson.

Consumption, 150,000 galls. *Pressure:* Ordinary, 72 lbs. Fire, 100 lbs.

Financial.—Cost, $250,000. Cap. stock, $125,000. Bonded debt, $125,000. Int., 6%. Ann. op. exp., $2,500. Ann. rev.: consumers, $7,000; city, $4,000. Hydrant rental, $3,500 for hydrants on first 6 miles of pipe; $45 for each additional.

Management.—Prest. and Supt., S. W. Holman. Treas., A. H. Howland, Boston, Mass.

FAYETTEVILLE, *Cumberland Co.* (Pop., 3,485; est., 5,000.) On Cape Fear river, at head of navigation. Manufactures cotton goods; is a shipping point for lumber, tar, turpentine and cotton. Settled about 1750. Incorp. No sewers. Has electric lights.

History.—Built in '29 by Fayetteville Water-Works Co.; leased since '75 to S. W. Tillinghast.

Water Supply.—Spring, about 30 ft. above general level of town, by gravity to and from brick reservoir.

Reservoir.—Cap., 6,000 galls.; brick.

Distribution.—*Mains*, wooden, 3-in. bore, 2 miles. *Services*, galv. i., wood, rustless iron. *Taps*, 100. *Meters*, none. *Hydrants*, 9.

Consumption, 86,000 galls. *Pressure*, 15 lbs.

Financial.—Cost, $4,500. Cap. stock, $5,000. Ann. op. exp., $500. Ann. rev.: consumers, $1,000; city, none.

Management.—Lessee and Supt., S. W. Tillinghast.

GOLDSBOROUGH, *Wayne Co.* (Pop., 3,286; est., 6,000.) On Neuse river. Trade and manufacturing center. Incorp. city. No sewers. Has electric lights.

History.—Built in '89 by Goldsboro Water Co., under 30-years franchise; put in operation Aug. 1, '89. Des. Engr., E. F. Fuller, N. Y. City. Const. Engr., Jno. W. Nelson.

Water Supply.—Little river, pumping to stand-pipe.

Pumping Machinery.—Dy. can., 2,000,000 galls.; Worthington; two 1,000,000 comp., cond. *Boilers:* from Dewey Bros., Goldsborough.

Stand-Pipe.—Cap., 209,000 galls., 18 x 110 ft.; from Tippett & Wood, Phillipsburgh, N. J.

Distribution.—*Mains*, c. i., 7½ miles. *Hydrants*, Ludlow, 54. *Valves*, Ludlow. *Pressure:* Ordinary, 75 lbs. Fire, 150 lbs.

Financial.—Cost, $100,000. Cap. stock, $100,000. Bonded debt, $75,000. Int., 6%. Hydrant rental, about $54.

Management.—Secy., Nathl. P. Hobart. Treas., R. I. Shannon.

GREENSBOROUGH, *Guilford Co.* (Pop., 2,105; est., 3,500.) In Gilmer and Morehead townships. Has manufactories.

History.—Built in '87-8 by Greensborough Water Co. Engr., W. W. Taylor. Work done by Co.

Water Supply.—North Buffalo creek and springs, pumping to tank.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Blake water-power, with auxiliary engine. *Boiler:* Babcock & Wilcox.

Tank.—Cap., 100,000 galls.; on brick tower, top 100 ft. high.

Distribution.—*Mains*, 2 to 4-in. c. i., 6¼ miles. *Services*, w. i., lead. Pipe and specials from R. D. Wood & Co., Philadelphia, Pa. *Taps*, 50. *Meters*, not given. *Hydrants*, Mathews, 80. *Valves*, Eddy.

Consumption, 150,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 75 lbs.

Financial.—Cost, $75,000. Cap. stock, $75,000. Bonds, $50,000. Int., 6%. Ann. op. exp. and rev.: not determined. Hydrant rental, $38.33 for 75, and $35 for each additional.

Management.—Prest., Thos. B. Keogh. Secy. and Treas., Fred B. Hubbell, 1225 Calvert St., Baltimore, Md. Supt., Hugh B. Peters.

HENDERSONVILLE, *Henderson Co.* (Pop., 554; est., 2,000.) Manufactures brooms, furniture and carriages.

History.—Built in '89-90 by town. Engr., L. Anderson, Cincinnati, O.

Water Supply.—Spring, by gravity.

Financial.—Cost, $20,000. Bonded debt, $20,000.

Management.—Chn., V. L. Hyman.

NOTE.—Jan. 7, '90, reservoir was about completed, and mains were to be laid in spring.

MONROE, *Union Co.* (Pop., 1,564; est., 2,500.) Engaged in general trade. Incorp. town.

General Description.—Built in '86 by town. Supply, by gravity to tank. *Mains*, ¾ mile. Cost (July, '88), $5,000. Debt (July, '88), $3,200. Int., 6%. Clerk, J. Miller Stewart.

NEW BERNE, *Craven Co.* (Pop., 6,443; est., 7,000.) At junction of Neuse and Trent rivers. Engaged in distilling turpentine, and in cotton, lumber and fishing industries.

General Description.—A. K. Dennison has laid 3,000 ft. of 3-in. pipe from artesian well, primarily for fire protection of his cotton gin and turpentine distillery. He proposed to double length of pipe in '89 and extend thereafter, as rapidly as possible. Est. cost, completed works, including pump and stand-pipe, $100,000.

RALEIGH, *Wake Co.* (Pop., 9,265; est., 15,000.) Important trade center in cotton, corn and tobacco region. Incorp. Has sewers and electric lights.

History.—Built in '87 by Raleigh Water Co., Engr., M. M. Moore, N. Y. City. Contr., National Water-Works Construction Co., Dayton, O.

Water Supply.—Walnut creek, 1¾ miles from city, pumping to tank, with direct pumping for fire protection. Water filtered.

Pumping Machinery—Dy. cap., 4,000,000 galls.; four 1,000,000 Smith & Vaile. *Water-wheels*, 2 turbines *Boilers:* two 40-H. P.

Filter.—Dy. cap., 300,000 galls. Hyatt. Larger filter projected in '89.

Tank.—Cap., 93,000 galls.; 23x30 ft.; on 90 ft. of masonry. Contrs., R. M. Mitchell & Co., and P. Linehan & Co., Raleigh.

Distribution.—*Mains*, c. i., 15 miles. *Services*, lead. Pipe and specials from R. D. Wood & Co., Philadelphia, Pa. *Taps*, 270. *Meters*, 18. *Hydrants*, Mathews, 122. *Valves*, Eddy.

Consumption, 300,000 galls. *Pressure*, 50 to 90 lbs.

Financial.—Cost, $184,000. Cap. stock, $100,000. Bonded debt, $160,000. Int., 6%. Ann. op. exp., $4,000. Ann. rev.: consumers, withheld, city, $4,480. Hydrant rental, $3,750, and $40 for additional; 20-years contract.

Management.—Prest., Julius Lewis. Secy., M. M. Moore, 112 Liberty St., N. Y. City. Treas., W. W. Smith. Supt., E. B. Engelhard.

SALEM, *Forsyth Co.* (Pop., 1,340; est., 3,500.) On middle fork of Muddy creek, on irregular ground. Has cotton, saw, grist and planing mills, and iron works. Settled in 1760; incorp. in '84. No sewers. Has electric lights.

History.—Built in '73 by Salem Water Supply Co. In 1890 works were built consisting of cisterns, located about town, filled by force pump.

Water Supply.—Two wells, pumping to reservoir. Wells are 10 ft. in diam., and near a creek. One has cap. of 40, one of 50 galls. a minute.

Pumping Machinery.—Dy. cap., 144,000 galls.; Worthington.

Reservoir.—Cap., 450,000 galls. Contrs., D. W. C. Carroll & Co.

Distribution.—*Mains*, c. i., 3½ miles. *Services*, w. i. Pipe and specials from R. D. Wood & Co., Philadelphia, Pa. *Taps*, 100. *Meters*, 92. *Hydrants*, kind not given, 36.

Consumption, 50,000 galls. *Pressure*, 80 lbs.

Financial.—Cost, $16,000. Cap. stock, $8,000. Debt, $5,000. Int., 6%. Ann. op. exp., $250. Ann. rev.: consumers, $1,600; city, none, as it furnishes its own hydrants

Management.—Prest., Frank H. Fries Secy., S. M. Clinard Supt., C. A. Fogle.

SALISBURY, *Rowan Co.* (Pop., 2,723; est., 5,000.) Has iron foundries and various manufactories. Incorp. No sewers or electric lights.

History.—Built in '87 by Moffett, Hodgkins & Clarke, Syracuse, N. Y., who were Engrs. and Contrs.

Water Supply.—Springs, pumping to tank.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; Worthington.

Tank.—No data.

Distribution.—*Mains*, c. i., 8½ miles. *Services*, galv. i. *Taps*, 80. *Meters*, 2. *Hydrants*, kind not given, 62.

Consumption, 84,400 galls. *Pressure:* Ordinary, 78 lbs. Fire, 120 lbs.

Financial.—Cost, $100,000. Debt, $85,000. Int., 6%. Ann. op. exp., $1,200. Ann. rev.: consumers, $4,800; city, $2,540. Hydrant rental about $40.

Management.—Prest., J. V. Clarke. Supt., E. B. Neave.

TARBOROUGH, *Edgecombe Co.* (Pop., 1,600.) On Tar River.

General Description.—Built in '89 by town. A 1,000,000-gall. Worthington pump in use. Mayor, W. E. Fountain.

WESTERN NORTH CAROLINA INSANE ASYLUM, *Morganton, Burke Co.* (Pop., 550.)

History.—Built in '76 by State. Engr., Roger P. Atkinson, deceased.

Water Supply.—Black Fox branch of Catawba river, by gravity from impounding reservoir.

Dam and Reservoir.—Cap., 400,000 galls.; is 40 x 125 ft. x 6 ft. deep; 4.7 miles from and 177½ ft. above Asylum. Dam of stone, 36 ft. long, about 10 ft. high, 2½ ft. thick at top, 4 at bottom; of coursed rubble masonry on footing of concrete 2 ft. thick and 2 ft. below bed of stream; backed with riprap, and has earth embankments at each end. *Spillway:* near center of dam, 18 ft. long, 3 ft. deep. *Gate-chamber:* 8 ft. sq. outside, 3 inside. *Discharge-pipes:* 2 6-in. supply and drain.

Supply Main.—Diam., 6 ins.; length, 4¾ miles; follows undulations of surface, not rising above hydraulic grade, but at one point is 200 ft. below reservoir. Air-

cocks are placed at summits and blow-offs at depressions. Ordinarily pipe trenches were 2½ ft. deep. Joints were made by springing in pipe, there being no sleeves. At each joint 5 lbs. of lead and 0.6 lbs. of oakum were used.

Distribution.—*Mains*, c. i., including supply main, 4.8 miles. *Services*, galv. i., *Taps* and *Meters*, none. *Hydrants*, 5.

Consumption, 75,000 galls. *Pressure*, 67 lbs.

Financial.—Cost, $23,000. No debt. Ann. op. exp., $150. No rev.

Management.—Engr. of Asylum, H. R. Hicks.

NOTE.—A detailed account of cost of pipe-laying is given in *Engineering News* vol. IX., p. 429.

WILMINGTON, *New Hanover Co.* (Pop., 17,350; est., 23,000.) On bluff on east bank of Cape Fear river, at head of navigation, 30 miles from ocean. Manufactures cotton goods, naval stores and machinery; has extensive commerce. Settled about 1750. Incorp. No sewers. Has electric lights.

History.—Built in '81-2 by Clarendon Water-Works Co. Contr., J. A. Cloud.

Water Supply.—Cape Fear river, pumping to stand-pipe, with direct pumping for fire protection. An 8-in. artesian well was in progress time of '89 report.

Pumping Machinery.—Dy. cap. 3,000,000 galls.; two dup., one comp., dup. Worthington.

Stand-Pipe.—Cap., 211,000 galls.; 20 x 90 ft.; from C. H. Delameter & Co.

Distribution.—*Mains*, c. i., 13.1 miles. *Services*, galv. w. i. Pipe and specials from Warren Foundry & Machine Co., Phillipsburgh, N. J. *Taps*, 527. *Meters*, 142. *Hydrants*, Chapman, 105 public, 19 private. *Valves*, Chapman.

Consumption, 506,785 galls. *Pressure:* Ordinary, 47 lbs. Fire, 100 lbs.

Financial.—Cost, $195,009. Cap. stock, $100,000, Bonded debt, $80,000. Int., 6%. Ann. op. exp., $7,350. Ann. rev.: consumers, $8,375; city, $7,275. Hydrant rental, $70 for first 75, $50 for next 30.

Management.—Prest., J. F. Divine. Treas., Geo. W. Kidder. Supt. and Engr., J. C. Chase.

WINSTON, *Forsyth Co.* (Pop., 2,854; est., 8,000.) On Piedmont range, 1,000, ft. above sea. Has large tobacco manufactories, an iron foundry, cotton and woolen mills. Incorp. No sewers. Has electric lights.

History.—Built in '81-2. by Winston Water Co., under 99-years franchise. Des. Engr., J. W. Andrews. Contr. Engr., Geo. W. Henshaw.

Water Supply.—Two wells, pumping to reservoir. *Old well:* 15 ft. diam., 30 ft. deep; brick wall 2 to 2½ ft. thick, upper portion laid in cem. *New well:* 30 ft. in diam., 52 ft. deep; dy. yield, 144,000 galls.

Dam.—Across small stream for power.

Pumping Machinery.—Dy. cap., 220,000 galls; Worthington water-power. *Water-wheel:* overshot; with supplementary engine.

Force Main.—C. i., 4-in., 2,000 ft. long; rise, 210 ft.

Reservoir.—Cap., 1,000,000 galls.; 79 x 78 ft., x 21½ ft. deep; 16 to 65 ft. above residence, 40 to 100 ft. above business section, and 210 ft. above pump. Walls of brick in Portland cem., 11 ft. thick at base, battered on outside from surface of ground to within 5 ft. of top, from which point to coping they are perpendicular, and 3 ft. thick.

Distribution.—*Mains*, c. i., 4¾ miles. *Services*, w. i., lead. Pipe and specials from R. D. Wood & Co., Philadelphia, Pa. *Taps*, 150. *Meters*, 100. *Hydrants*, Mathews, 45. *Valves*, Eddy.

Consumption, 120,000 galls. *Pressure*, 15 to 45 lbs.

Financial.—Cost, $52,000. Cap. stock, $19,000. Total debt, $28,966; bonds, $24,000 at 8; floating $1,466 at 8, $3,500 at 6%. Ann. op. exp., $1,209. Ann. rev.: consumers, $3,316; city, $1,125, Hydrant rental, $25; 20-years contract from '80.

Management.—Prest., Thos. J. Wilson. Supt., Secy. and Treas., Geo. W. Henshaw.

Water-Works Projected with Fair Prospects of Construtions.

HENDERSON, *Vance Co.* (Pop., est., 4,500.) In tobacco and cotton district.

Proposed Works.—Sept. 15, '89, Wm. H. Burgoyne stated that he had charter and hoped Co. would build within a year. Dec. 3, '89, J. H. Bridgers, Town Clerk, stated that town was having surveys made. See MANUAL for '88, p. 263.

RUTHERFORDTON, *Rutherford Co.* (Pop., est., 800.) Manufactures leather and harness.

Proposed Works.—Town has voted bonds for works to cost from $2,500 to $3,000. Supply, springs, pumping to tank. Nothing definite Jan. 11, '90.

STATESVILLE, *Iredell Co.* (Pop., 1,062; est., 2,000.) Center of trade.

Proposed Works.—To be built in '90. Not determined by whom. Supply, spring branch, pumping to stand-pipe. Est. cost, $25,000. Chn. Com., A. J. Evans. Date report, Oct. 30, '89.

Water-Works Projects Reported in '89 and 90, but now Indefinite.

Blowing Rock, Watauga Co. *Hickory*, Catawba Co. *Lincolnton*, Lincoln Co. *Oxford*, Granville Co.: see MANUAL for '88, p. 264. *Spring Hill*, Halifax Co.

SOUTH CAROLINA.

Water-Works Completed or in Process of Construction.

ANDERSON, *Anderson Co.* (Pop., 1,850; est., 3,500.) Manufactures oil and fertilizers.

General Description.—Contracts let Nov. 19, '89, by Anderson Water Supply Co.; hoped that works would be completed by June 1, '90. Supply, Generosta creek, pumping to reservoir. Prest., W. W. Humphreys. Gen. Mgr. and Chf. Engr., Wm. C. Whitner. Secy. and Treas., Jno. T. Roddey. Dates reports about Jan. 1 and March 24, '90.

CHARLESTON, *Charleston Co.* (Pop., 49,984; est., 60,000.) At junction of Ashley and Cooper rivers, 7 miles from ocean, with fine harbor and large foreign and domestic commerce. Streets are somewhat irregular, as tide-water, creeks and ponds and marshy spots formerly covered a portion of the thickly settled part of city, which is now from 8 to 12 ft. above high-water. As early as 1680 there was a settlement here called "Charles Town." In 1783 it was incorp. as Charleston. Has sewers and electric lights.

History.—Built in '76-80, and now owned by the City of Charleston Water-Works Co.

Since '24 five attempts have been made to obtain good water from artesian wells. (See MANUAL for '88.)

In '79, City Council made a contract for works with Jesse W. Starr. System was partly completed in '80, but contractor not fulfilling agreements his contract was annulled, and in Jan., '81, another one made with the present company, who had bought a large part of the first issue of stock.

Water Supply.—Three artesian wells, pumping to stand-pipe for domestic supply; water passes to reservoir, and is stored for fire protection. Wells are, in order of sinking, 1,974, 1,970 and 2,000 ft. deep; 2 11-16, 3¼ and 4 ins. in diam. at bottom, with dy. flows of 250,000, 350,000 and 500,000 galls. First well, sunk in '76, cost, $25,000; second, cost about $30,000; third, sunk '88-9, cost, $40,000.

Pumping Machinery.—Dy. cap., 6,000,000 galls.: two 3,000,000 Knowles.

Force Main.—Diam., 20 ins.

Stand-Pipe.—Cap., 170,000 galls.; 18 x 90 ft.

Reservoirs.—Cap., 13,000,000 galls. *Old:* cap., 3,000,000 galls.; in excavation 12 ft., with 8-ft. embankments. Bottom of shell formation, upon which is 12 ins. of puddled clay, then brick laid in gravel, grouted with cem. Walls have 2 ft. of puddle, upon which are two courses of brick laid edgewise in cem. East wall sunk several inches, making a crack at each angle, which was filled with cem. *New:* cap., 10,000,000 galls. It was unofficially reported that this reservoir failed soon after being filled, owing to leakage.

Distribution.—*Mains*, c. i., 18 miles. *Services*, galv. i., lead. *Taps*, 1,000. *Meters*, 20. *Hydrants*, Chapman, Ludlow, about 300. *Valves*, Chapman, Ludlow.

Consumption, 1,000,000 galls. *Pressure*, 40 lbs.

Financial.—Cost, withheld, est., $400,000 (including cost and loss incident to early mismanagement and reorganization). Cap. stock, "nominal." Bonded debt (in '87), $400,000: $200,000 at 6, and $200,000 at 5%. First issue was $250,000 of 6% bonds,

but with reorganization these were scaled down to $200,000 at 5%. Ann. op. exp., withheld, est., $4,000. Ann. rev.: consumers, withheld, est., $20,000; city, $11,500; $9,000 for first 12 miles, $333.33 for each additional mile.

Management.—Prest., Geo. I. Cunningham. Secy. and Treas., Zimmerman Davis.

COLUMBIA, *Richland Co.* (Pop., 10,036; est., 15,000.) On Congaree river; business and manufacturing center.

History.—Built by city; date not given. Engr., D. B. Miller. Extensions made in '88.

Water Supply.—Congaree river and springs, pumping to reservoir.

Pumping Machinery.—Dy. cap., not given; Worthington.

Reservoirs.—Cap., 6,500,000 galls.; old, 1,500,000; new, 5,000,000 galls.

Distribution.—(In '87.) *Mains*, 12 to 4-in., material not given, 16 miles. *Services*, not given. *Taps*, withheld, est., 500. *Meters*, not given. *Hydrants*, kind not given, about 110.

Consumption (in '87), 600,000 galls. *Pressure*, 20 to 60 lbs.

Financial.—Cost, withheld, est., $180,000. Cap. stock, debt and int., withheld. Ann. op. exp., $7,000. Ann. rev., withheld, est., $25,000.

Management.—(In '88.) City Council. Supt., Henry Alexander. City Clerk and Treas., Wm. J. Cathcart.

NOTE.—No reply to inquiries sent in '89.

ORANGEBURGH, *Orangeburgh Co.* (Pop., 2,140; est., 4,000.)

History.—Built in '87, artesian wells being owned by Geo. H. Cornelson and distribution by town. In '89 distribution was bought by Mr. Cornelson, and extended through principal streets. At expiration of ten years city has option of rebuying works or renewing contract for ten years.

Water Supply.—Two artesian wells, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., not given; a Knowles and a Worthington. A 1,440,000 Worthington was added to above in '89.

Stand-Pipe.—Cap., 35,000 galls.; 8 x 94 ft.; 20 ft. was added in '89.

Distribution.—*Mains*, 6 and 3-in. (summer of '89), 6 miles. *Services*, *Taps* and *Meters*, not determined. *Hydrants*, Chapman, 124. *Valves*, Chapman.

Consumption, not determined. *Pressure*, 40 lbs.

Financial.—Cost, est., $30,000. Hydrant rental, $2,000 for all. Other data not determined.

Management.—Owner, Geo. H. Cornelson.

SPARTANBURGH, *Spartanburgh Co.* (Pop., 3,253; est., 4,500.) Has iron mines and limestone quarries. Incorp. city. No sewers or electric lights.

History.—Built in '88-9 by Spartanburgh Water-Works Co.; put in operation May 10. Engr., E. H. Burlingame, Providence, R. I. Contrs., Moffett, Hodgkins & Clarke, Syracuse, N. Y.

Water Supply.—Chinquapis creek, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 2,000,000 galls; Worthington; two 1,000,000 dup., one comp., one high-pressure. *Boilers*: from Sharon, (Pa.) Boiler Works.

Stand-Pipe.—Cap., 216,000 galls.; 20x92 ft.; from Riter & Conley, Pittsburgh, Pa.

Distribution.—(Sept. 1, '89.) *Mains*, 10 to 4-in. c. i., 7 miles. *Services*, galv. i. Pipe and specials from Chattanooga (Tenn.) Foundry & Pipe Works. *Taps*, 67. *Meters*, Crown, 2. *Hydrants*, Chapman, 60. *Valves*, Chapman.

Consumption, 29,930 galls. *Pressure:* Ordinary, 50 lbs. Fire, 100 lbs.

Financial.—Cost, $100,000. Cap. stock, $100,000. Debt, $85,000. Int., not given. Ann. op. exp., est., $1,200. Ann. rev.: consumers, est., $3,500: city, $2,800. Hydrant rental, $46.66.

Management.—Prest., H. C. Hodgkins. Supt., E. D. Ball.

Water-Works Projected with Fair Prospects of Construction.

AIKEN, *Aiken Co.* (Pop., 1,817; est., 2,000.) Winter resort for consumptives, 17 miles east of Augusta, Ga. Has cotton trade.

Proposed Works.—It is hoped that Co. will be organized to build in '90. Address P. A. Emanuel or Jno. T. Gaston. Latest data, Mar. 26, '90.

BAMBERG, *Barnwell Co.* (Pop., 618.)
Proposed Works.—Town completed artesian well on Main St. in Feb., '90; dy. yield, about 275,000 galls. In Mar. town thought of sinking well deeper. Contrs. for well, Jennings & Bamberg.

BARNWELL, *Barnwell Co.* (Pop., 648; est., 3,000.)
Proposed Works.—Town has artesian well with dy. yield of about 275,000 galls. Apr. 20, '89, town proposed to pump to reservoir. Privilege to bond had been granted by Legislature. Mayor D. P. Belinger. No later data could be obtained.

BATESBURGH, *Lexington Co.* (Pop., 286; est., 600.)
Proposed Works.—Artesian wells discussed, as surface water wells are thought to be contaminated with surface drainage. Mayor E. F. Strother.

ROCK HILL, *York Co.* (Pop., est., 800.)
Proposed Works.—Address Roddey & Whitner, Anderson.

SUMTER, *Sumter Co.* (Pop., 2,011.)
Proposed Works.—Latter part of '89 effort was being made to have works built by Sumter Electric Light Co. Works have been projected since '87. See MANUAL for '88, p. 265.

Water-Works Projects Reported in '89 and '90, but Now Indefinite.

Darlington, Darlington Co. *Florence*, Florence Co. *Seneca*, Oconee Co.: see MANUAL for 88, p. 265. *Union*, Union Co.

GEORGIA.

Water-Works Completed or in Process of Construction.

AMERICUS, *Sumter Co.* (Pop., 3,635; est., 7,000.) On Muckalee creek, in cotton district. Has manufactories. Incorp. city. No sewers. Has electric lights.
History.—Put in operation Aug. 1, '88, by city. Engr., Capt. Wilcox, Macon. Contrs., Jeter & Boardman Gas and Water Assn., Macon.
Water Supply.—Springs, pumping to tank.
Pumping Machinery.—Dy. cap., not given; Dean. *Boilers:* from Schofield & Son, Macon.
Tank.—Cap., 175,000 galls.: on tower; built by Contrs.
Distribution.—*Mains*, 8 to 4-in. c. i., 8 miles; from R. D. Wood & Co., Philadelphia, Pa. *Services*, ¾ and ½-in., material not given. *Taps*, 250. *Meters*, Crown, Hersey, 7. *Hydrants*, Mathews, number withheld.
Consumption, 100,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 60 to 80 lbs.
Financial.—Cost, $40,000. Further data withheld.
Management.—Comrs. Chn., U. B. Harold. Secy. and Treas., D. K. Prinson, Supt., C. J. Hawkins.

ATHENS, *Clarke Co.* (Pop., 6,099; est., 10,000.) On Oconee river in hilly country. Does considerable manufacturing. Settled about '10. Incorp. No sewers. Has electric lights.
History.—Built in '82-3 by Athens City Water-Works Co., under 30-years franchise. Engr., Chas. H. Ledlie, St. Louis, Mo. All labor done by Co.
Water Supply.—Two spring-fed creeks, pumping to stand-pipe. Direct pumping can be used. There are six springs issuing from sandstone.
Impounding Reservoir.—Cap., 23,000,000 galls.
Pumping Machinery.—Dy. cap., 1,750,000 galls.; two Blake; 750,000 and 1,000,000 one being comp., cond.; other, high-pressure, used for fire protection.
Stand-Pipe.—Cap., 366,000 galls.; 18½x100 ft.; from Cunningham Iron Works, Boston.
Distribution.—*Mains*, c. i., 8 miles. *Services*, w. i. Pipe and specials from Chattanooga (Tenn.) Foundry & Pipe Works. *Taps*, 285. *Meters*, 13. *Hydrants*, Ludlow, 64. *Valves*, Ludlow.
Consumption, 125,000 galls. *Pressure*: Ordinary, 80 lbs. Fire, 112 lbs.
Financial.—Cost, $123,000. Bonded debt, $75,000. Int., 5%. Sinking fund, $750. Ann. op. exp., $2,500. Ann. rev.: consumers, $7,000; city, $3,840. Hydrant rental, $60.

Management.—Prest., Wm. H. Howell, Box 2640 N. Y. City. Secy., G. M. Church. Supt., W. McKinnon.

Reference.—"Construction of Dam and Reservoir at Athens, Ga." Jour. Assn. Eng. Soc., Apr., '88. Also *Eng. News*, vol. XIX., pp. 354-5.

ATLANTA, *Fulton Co.* (Pop., 37,409; est., 66,000.) Is 1,100 ft. above sea. Trade and manufacturing center. Settled in '45 as Marthasville; incorp. city in '47 under its present name. Has sewers and electric lights.

History.—Built in '74-5 by city. Des. Engr., A. R. Ketchum. Const. Engr., Jno. A. Grant. In '89 city employed Rudolph Herring as Consult. Engr. to report on new supply.

Water Supply.—Direct pumping from impounding dam on headwaters of South river. Drainage area, about 12 sq. m. of sandy ground, overlying clay, and containing many springs. Water muddy, but by filtering good quality is secured. Water pumped from artesian well is also used to supply 108 drinking hydrants at street corners. This plant was put in before filter was erected, on account of muddy water.

Dam and Reservoir.—Cap , 250,000,000 galls.; area, 52 acres; depth at dam, 42 ft. Dam of earth, mostly clay, with heart-wall; 300 ft. long, 50 ft. high, 18 ft. wide at top, 300 at bottom. Inner slope, 2 to 1, riprapped; outer, terraced, sowed with Bermuda grass. *Heart-wall:* red clay puddle, built 10 ft. into banks of ravine at each end: 20 ft. thick at base, 6 at top, carried below natural surface and to top of dam. *Spill-way:* in rock and earth, large enough to carry whole flow of stream; slope, 2 ft. to 100. No other data. *Discharge-Pipe:* 30-in. waste, for surplus flow of stream. No leaks. Built in '74. Engr., Jno. A. Grant. Contrs., Grant, Alexander & Co.

Pumping Machinery.—Dy. cap., 6,000,000 galls.; Holly quadruplex and six tubular boilers.

Filtering Plant.—Dy. cap., 3,000,000 galls.; Hyatt; erected June, '87; showed dy. cap. of over 4,000,000. Plant put in operation, Nov., '87. There is a clear water basin 45 x 95 ft., x 25 ft. deep, two sides and one end being of brick, and other end of large stone in cem., with backing of earth all round.

Walls are about 10 ft. thick at bottom, 3 at top. Bottom covered with cem. Reservoir was partly filled before earth was packed around the two sides which are in embankment, and these sides gave way. They were successfully repaired.

Alum used in filter, Jan., '89, one grain to 1.83 galls. of water filtered.

Tank.—Cap. not given., Erected in '86 in connection with the artesian well supply. Contr., J. W. Baum.

Distribution.—*Mains*, c. i., 27 miles. *Services*, lead. Pipe and specials from R. D. Wood & Co., Philadelphia, Pa., and Dennis Long & Co., Louisville, Ky. Trenching and pipe-laying done by Hunnicutt & Billingrath, Atlanta. *Taps*, 2,466. *Meters*, 2,286. Adoption of meters has proved great saving to city, reducing pumpage and increasing pressure. They have worked much better since filtering plant was put in. Unfortunately the consumers choose their own meter, often putting in a size smaller than service-pipe. Thus "runs the meter to death." *Hydrants*, Mathews, Ludlow, Holly, Chapman, Galvin, 440. *Valves*, Morris & Tasker, Galvin, Chapman.

Consumption, 1,718,391 galls. *Pressure:* Ordinary, 40 lbs. Fire, 120 lbs.

Financial.—Cost, $483,814. Debt (in '87), $440,000. Int., 7%. Ann. op. exp., $21,500. Ann. rev., $43,347; city, none.

Management.—Six Comrs. Prest., C. C. Hammock. Secy., G. W. Terry, Jr. Supt., W. G. Richards.

AUGUSTA, *Richmond Co.* (Pop., 21,891; est., 46,000.) On Savannah river at head of navigation, 147 ft. above mean low tide. On level plain, soil being composed of alternate layers of sand and clay with coarse sand and pebbles for depth of 75 ft. Engaged in manufacturing and cotton trade. Laid out by Gen. Oglethorpe in 1735; incorp. a town in 1796, and chartered a city in '18.

History.—Supplied from '28 to '61 by Turknett Springs Water-Works. In '59 to '61 city built works which were enlarged in '84. Jan. 1, '82, Turknett Springs system was abandoned. For the works built in '59-61, Alfred W. Craven, N. Y. City, was Des. Engr., his plans being somewhat changed by Const. Engr., Wm. Phillips. Engr. for work done in '84, A. H. Davidson, City Engr.

Mar., '28, City Council granted right to furnish city with water to Thos. McGrew, who built Turknett Springs Water-Works, taking water by gravity from spring 2¼ miles southwest of city. July 15, '29, he conveyed the works to Wm. Hale, then Mayor, who sold them to city on Mar. 26, '40, for $1,800. System was then extended.

Pipes were of native pine logs, supply main, 6-in., distributing mains, 6 to 3-in.,

services, 3-in. bore. Latter had upright end, water being taken through a 2-in. orifice by withdrawing pine plug. Springs were 13 ft. above city. After introduction of new supply in '61 consumers of this water gradually fell off, price being $20 a family or hydrant. In '76 there were 291 takers, in '79, 184, and in '80, 176. Dy. cap. of this source in '77 was 186,256 galls. Disbursements for this system from '49, when bought by city, to Jan. 1, '81, had been $302,702, and receipts, $101,815.

Water Supply.—Savannah river, through Augusta canal and settling basins, by direct pumping and pumping to tank.

Dam.—Across Savannah river to divert water to Augusta canal; stone and cem., 1,700 ft. long; av. height on Ga. side, 12 ft., on S. C. side, 9 ft. Top 6½ ft. wide, sloping 15 ins. toward inner side. Inner slope, 1½ to 1; outer, 1 to 1. Water flows over top throughout entire length. Date built not given; enlarged in '87. Des. Engr., C. A. Olmstead, deceased. Const. Engr., Byron Holley, Columbia, S. C. Cost, including canal, $1,000,000.

Augusta Canal.—Built to furnish water-power for manufacturing purposes. Extends from dam to city, 7 miles, and has branches in city 2 miles long. It also receives wholesome water from seven streams. Sectional area of canal at entrance, 1,462 ft. Width, 150 ft. at water surface, 106 ft. at bottom; av. depth of water, about 8 ft. Banks of earth sloping, 2 to 1, covered with loose stone, 10 to 20 ft. high. For Engrs. and cost see Dam, above.

Settling Basins.—Three, adjoining canal, within city limits; made necessary by large amount of clay in suspension carried by river water. First basin receives water from canal, is 10 ft. deep; thence water passes to second basin, 200 ft. sq. x 15 ft. deep. This was designed to act as a filter, but the war prevented its completion as such, and water simply passes through the ¼-in. joints of the brick paving to third, or clear water basin. This is 15 ft. deep, and water passes from it through a conduit to the pump-well.

Conduit and Pump-well.—Conduit is 3,443 ft. long, of 20-in. c. i. Pump-well is of ¼-in. plate iron, 9 ft. in diam., 24 ft. deep. Bottom of well is 17 ft. below water surface of basins.

Pumping Machinery.—Dy. cap., 8,000,000 galls.; 5,000,000 R. D. Wood & Co. water-power, 3,000,000 Worthington. The two old pumps were made by I. P. Morris & Co., were double-acting, with 18¼-in. barrels, 12-in. plungers, 36-in. stroke; operated by Jonval turbine under 11 ft. head and fall. There has also been a small auxiliary steam engine with double-acting force pump of 20-in. bore and stroke.

Force Mains.—(In '81.) A 16-in. c. i. main, which at 130 ft. from air chamber branched north 370 ft. to tank, and south 2,360 ft. to Broad and Ninth streets, where four 6-in. mains radiated, supplying greater part of city by direct pumping.

Tank.—Of ¼-in. plate-iron, 37 ft. in diam. and 30 ft. high, with central core 7 ft. in diam. through which staircase is carried. Tank supported by 32 c. i. girders resting on two annular brick walls, 84 ft. high, founded on 3 ft. of concrete. Outer ring is 39¼ ft. in diam., and 3¾ ft. thick at bottom, and inner 12½ ft. in diam. and 2.67 ft. thick at bottom. Both are 18 ins. thick at top. Water surface in tank is 196.32 ft. above the pumps, and 96 ft. above Broad and Ninth streets. In '81 tank supplied one 6-in. pipe leading south.

Distribution.—*Mains*, c. i., 35½ miles. *Services*, galv. i. *Taps*, (in '86,) 1,728. *Meters*, none. *Hydrants*, McClennan, Mathews, Ludlow, Eddy, 293. *Valves*, kind, do. *Consumption* 2 572,193 galls. *Pressure:* Ordinary, 35 lbs. Fire, 60 lbs.

Financial.—Cost and debt to date not given, as these items are not kept separate from city finances. Est. cost, $500,000. Original cost, $200,000. Disbursements to Dec. 31, '81, $361,432; receipts, $131,485. Ann. op. exp., $8,523. Ann. rev.: consumers, $26,551.

Management.—Com. of four. City Engr., A. H. Davidson. Supt., Wm. Bennett.

BAINBRIDGE, *Decatur Co.* (Pop., 1,435; est., 1,800.) On Flint river. Incorp. No sewers or electric lights.

History.—Built in '82-6 by town. No Engr. employed. Wells were sunk in '82: Contrs., Jno. Pfeiffer & Co., Cincinnati. Contr. for masonry, L. F. Patterson: for buildings, J. I. Robinson. Both of Bainbridge.

Water Supply.—Artesian wells, pumping to tank.

Pumping Machinery.—Dy. cap., 32,000 galls.; Knowles.

Tank.—Cap., 32,000 galls. 8 x 17 ft., from King Iron Bridge Co., Cleveland, O.

Distribution.—*Mains*, 6-in., material not given, 6 miles. *Services*, ½ and ¾-in., kind not given. *Taps*, 150. *Meters*, none. *Hydrants*, Holyoke, 20.

Consumption, 15,000 galls. *Pressure*, 15 lbs.

Financial.—Cost, $15,000. Bonded debt., $7,000. Int., 7%. Ann. op. exp., $700. Ann. rev.: consumers, withheld, est., $3,000; city, none.

Management.—City Council. Report by J. D. Bradwell.

BRUNSWICK, *Glynn Co.* (Pop., 2,891; est., 6,000.) On inlet of Atlantic Ocean; good harbor. Incorp. No sewers. Has electric lights.

History.—Built in '86 by Brunswick Light & Water Co., under 20-years franchise. Engr., A. E. Boardman, of Jeter & Boardman, Macon, Ga., Contrs.

Water Supply.—Artesian well, pumping to tank.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Worthington.

Tank.—Cap., 112,600 galls.; on tower.

Distribution.—*Mains*, c. i., 13 miles. *Services*, galv. w. i. *Taps*, 411. *Meters*, Worthington, 5. *Hydrants*, Mathews, 56. *Valves*, Eddy.

Consumption, 400,000 galls. *Pressure:* Ordinary, 42 lbs. Fire, 100 lbs.

Financial.—Cost, $96,000. Cap. stock, $50,000. Bonded debt, $50,000. Int., 7%. Ann. op. exp., withheld, est., $2,500. Ann. rev.: consumers, $6,975; city, $3,750. Hydrant rental, $50.

Management.—Prest. and Treas., W. E. Burbage. Secy., J. B. Hall. Supt., W. H. Gober. Report by A. E. Boardman, Macon, Director.

CARTERSVILLE, *Bartow Co.* (Pop., 2,037; est., 4,500.) In agricultural and mineral section. Incorp. city. No sewers or electric lights.

History.—Built in '89 by Cartersville Water Co. under 30-years franchise; put in operation in Aug. Engr., A. E. Boardman, Macon. Contrs., Jeter & Boardman Gas & Water Assn., Macon.

Water Supply.—Springs on bank of Etowah river, pumping to tank.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; Worthington; two 1,000,000 dup. *Boilers:* from J. S. Schofield & Son, Macon.

Force Main.—Diam., 12 ins.; length, about 2 miles.

Stand-Pipe.—Cap., 367,000 galls.; 25 x 100 ft.; from Contrs.

Distribution.—*Mains*, 10 to 4-in. c. i., 7 miles; from So. Pittsburgh (Tenn.) Pipe Works. *Services*, galv. i. *Taps*, 40. *Hydrants*, Bourbon, 50. *Valves*, Bourbon.

Pressure, 70 lbs.

Financial.—Cost, $80,000. Cap. stock, $50,000. Bonded debt, $50,000. Int., 6%. Hydrant rental, $50.

Management.—Prest., J. S. Baxter, Macon. Secy., Douglas Wilke. Treas., A. E. Boardman, Macon, Supt., M. N. Driggers.

COLUMBUS, *Muscogee Co.* (Pop., 10,123; est., 30,000.) At head of navigation on Chattahoochee river. Has extensive cotton manufactories. Incorp. city in '27.

History.—Built in '82 by Columbus Water-Works Co. Engrs., Jacob H. Yocum and T. R. White. Work done by Co.

Water Supply.—Headwaters of Holland's creek, Ala., by gravity from impounding reservoirs to stand-pipe. Drainage area, 12 sq. m.; est. dy. flow, 15,000,000 galls., after allowing one-half rainfall for absorption and evaporation.

Dams and Reservoirs.—Cap., 120,000,000 galls.; two, near together, formed by dams across ravine.

Upper: cap., 100,000,000 galls.; 130½ ft. above city; land flooded was originally covered with timber and cane; stumps and roots were grubbed out and muck removed. Dam of stone, 266 ft. long, 21 ft. high, with overflow; abutments and slope-walls at each end, and 4 and 6-ft. dyke-walls running from these each way to fast land. All these walls of stone in hydraulic mortar. On both sides of dyke-walls were clay and gravel embankments placed in layers of about 4 ins., tamped, clay being next to wall. Inner slope, paved with spalls from reservoir; the outer, covered with black earth and Bermuda grass. Built in '84.

Lower: cap., 20,000,000 galls.; 115½ ft. above center of city. Dam of stone blasted from reservoir, laid in cem. mortar; 250 ft. long, height not given.

Filter.—On inside of reservoir, 16 ft. sq., packed with charcoal.

Conduit.—C. i., 12-in., 13,009 ft. long, crossing Chattahoochee river by two 9-in w. i. pipes, 900 ft. long, laid beneath floor girders of one of city bridges.

Stand-Pipe.—Cap., 280,000 galls.; steel, 20 x 120 ft.; from Union Iron Works, Chattanooga, Tenn.

Distribution.—(In '87.) *Mains*, c. i., 14 miles. *Services*, galv. w. i. *Taps*, 800. *Meters*, 40. *Hydrants*, Cassin, 85.

Consumption, not given. *Pressure*, 36 to 50 lbs.

Financial.—Cost (in '87), $200,000. Cap. stock (in '84), $150,000. Bonded debt and int., withheld. Ann. op. exp., withheld, est., $3,000. Ann. rev.: consumers, withheld, est., $13,000; city, $6,800. Hydrant rental, $80.

Management.—(In '88.) Prest., B. F. Archer Secy. and Treas., Geo. Bailey. Supt., M. H. Taggle.

NOTE.—No replies to inquiries sent in '89.

ROSE HILL WATER CO.

Proposed Works.—March, '90, Co. applied for 20-years charter, with $70,000 of cap. stock. Proposes to supply elevated annexed district, known as Rose Hill, and possibly other parts of city, by pumping from two streams about 3 miles north of city, Chattahoochee river, or gang-wells to reservoir or stand-pipe. Hopes to eventually extend supply over city. Co. not organized. Report by F. D. Peabody; date, Mar. 21, '90.

DALTON, *Whitfield Co.* (Pop., 2,516; est., 3,500.) In agricultural region. Incorp. No sewers or electric lights.

History.—Built in '88 by town. Engr., L. J. Wagner, Rome. Contrs., Union Iron Works, Chattanooga, Tenn.

Water Supply.—Spring, pumping from settling reservoir to stand-pipe.

Settling Reservoir.—Cap., 188,000 galls.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; two 500,000 comp., dup., Gordon & Maxwell.

Stand-Pipe.—Cap., 188,000 galls.; steel.

Distribution.—*Mains*, c. i., 5¼ miles. *Services*, w. i. *Taps*, 136. *Meters*, none. *Hydrants*, Cincinnati, 39. *Valves*, Scott.

Consumption, 75,000 galls. *Pressure*, 70 lbs.

Financial.—Cost, $32,000. Bonded debt, $30,000, 30-year. Int., 5%. Sinking fund, $1,000. Ann. op. exp., $1,000. Ann. rev.: consumers, $1,500.

Management.—Supt., C. G. Spencer. Report by J. R. McAfee.

FORT GAINES, *Clay Co.* (Pop., 867; est., 2,000.) On Chattahoochee river. Incorp. Has sewers. No electric lights.

History.—Built in '77-8 by town Engr. and Contr., J. W. Baum, Atlanta.

Water Supply.—Artesian well, 4 ins. in diam., pumping to tank.

Pumping Machinery.—Dy. cap., 216,000 galls.; Deane.

Tank.—Cap., 21,000 galls.

Distribution.—*Mains*, 4-in. black i., 2,000 ft. *Hydrants*, P. White, 16.

Consumption, 12,000. *Pressure*, 70 lbs.

Financial.—Cost, $2,000. Debt, $300. Ann. op. exp., $550. Ann. rev., $300.

Management.—Mayor, W. M. Speight.

MACON, *Bibb Co.* (Pop., 12,749; est., 23,000.) On Ocmulgee river. Business portion is on level ground between the river, swamp and range of hills. Most of residences are on hills. Has large cotton and other trade. Settled in '22; incorp. town in 23, city in '32.

History.—Built in '81 by Macon Gaslight & Water Co. Engr., A. E. Boardman. Work done by Co. It was unofficially reported in '89 that works had been sold to English syndicate, known as Anglo-American Water & Gas Co.

Water Supply.—Springs, pumping to reservoir and tank. Springs are two miles from center of city; water conveyed from them to pump-well near by.

Pumping Machinery.—Dy. cap., 3,000,000 galls; two comp., dup., Worthington. *Boilers:* three return tubular; 175-H. P.

Force Main.—*Old:* 7,780 ft. 12-in. c. i.; rise, 150 ft. *New:* 14-in., added in '89.

Reservoir.—Cap., 2,500,000 galls.; 100 x 220 ft., x 26 ft. deep; on side hill, in excavation and embankment, puddled and lined with 6 ins. of concrete. Water surface 127 ft. above city.

Tank.—Cap., 75,000 galls.

Distribution.—*Mains*, c. i., 32½ miles, 9 miles laid by Inman Bros., N. Y. City. *Services*, galv. i. Pipe and specials from R. D. Wood & Co., Philadelphia, Pa. *Taps*, 1,500. *Meters*, 248. *Hydrants*, Mathews, 200. *Valves*, Eddy.

Consumption, 1,600,000 galls. *Pressure*, 50 lbs.

Financial.—Cost, $287,000. Remaining data for '87. Cap. stock, $150,000. Bonded debt, $115,000. Int., 6%. Ann. op. exp., $9,850. Ann. rev.: consumers, $21,000; city, $8,600. Hydrant rental, $40.

Management.—Prest., B. Van Steinberg. Secy. and Treas., G. F. Work. Supt., J. M. Wilcox.

RISING FAWN, *Dade Co.* (Pop., 1,128; est., 1,500.)

NOTE.—Mar. 10, '90, G. W. Cureton stated that he would have works in operation Apr. 1, '90. Supply, spring on side Fox Mt., by gravity from reservoir. Cost, about $10,000; cap. paid in.

ROME, *Floyd Co.* (Pop., 3,877; est., $10,000) On Coosa river, in agricultural section; center of trade. Incorp. Partially sewered. Has electric lights.

History.—Built in '71 by city. Contrs., Noble Bros. & Co.

Water Supply.—Wells, pumping to stand-pipe. First well was 12 ft. in diam., 50 ft. deep, with tunnel extending 30 ft. each way from bottom. Two 12-in. wells were sunk in '87, one being 96, and the other 116 ft. deep.

Pumping Machinery.—Dy. cap., 1,500,000 galls. First pump had cap. of 700,000 galls., and was beam engine with 20 x 42-in. steam, and 16-in. water cylinder.

Stand-Pipe.—Cap., 230,000 galls.; w. i., 25 x 63 ft., on hill in center of city. Flow-line is 200 ft. above water in first well.

Distribution.—*Mains*, c. i., 10 miles. *Services*, w. i. *Taps*, 625. *Meters*, 45. *Hydrants*, Mathews, 80. *Valves*, Ludlow.

Consumption, 350,000 galls. *Pressure*, 77 lbs.

Financial.—Cost, $96,000. Debt, $85,000. Int., 6%. Ann. op. exp., $4,000. Ann. rev.: consumers, $8,000; city, none.

Management.—Supt., L. J. Wagner.

SAVANNAH, *Chatham Co.* (Pop., 30,709; est., 52,000.) On right bank of Savannah river, 18 miles from its mouth, on sandy plain 40 ft. above river, with one narrow street below steep bluff. Engaged in foreign and domestic commerce, handling large amounts of cotton, rice, rosin and turpentine. Settled in 1733.

History.—Built in '53-4 by city. Des. Engr., J. D. Cook, Toledo, O.; Const., Engr., Henry R. Worthington, N. Y. City; Contr., for masonry, C. C. Casey; for buildings, C. Vanhorne. In '89 boring was begun to obtain, if possible, flowing wells; if successful new works will be built.

Water Supply.—Since '87 nine artesian wells, by direct pumping; prior to this, Savannah river, pumping to settling basins for low, and to reservoir for high service. Latter source can still be used in case of necessity. No wells over 400 ft. deep.

Old Settling Basins.—Four, each of 1,000,000 galls. cap.; bottoms covered with concrete and their sides paved with brick, and being 130 ft. above pumps.

Tank.—Cap., 185,000 galls., 36 x 30 ft.; on brick foundation. Not in use, but kept in order for immediate service.

Pumping Machinery.—Dy. cap., 6,000,000 galls.; Worthington.

Distribution.—*Mains*, c. i., 34½ miles. *Services*, lead. w. i. Pipe and specials from R. D. Wood & Co., and Gloucester Iron Works, Philadelphia, Pa. Trenching and pipe-laying done by city. *Taps*, 2,850. *Meters*, 2. *Hydrants*, Chapman, 312.

Consumption, 6,000,000 galls. *Pressure:* Ordinary, 43 lbs. Fire, 45 lbs.

Financial.—Cost, $1,000,000. Bonded debt and int., not given. Ann. op. exp., $21,000. Ann. rev.: consumers, $52,000; city, none.

Management.—City Council. Supt. and Engr., Alvin N. Miller.

THOMASVILLE, *Thomas Co.* (Pop., 2,555; est., 6,500.) In cotton and sugar cane region. Also a winter resort. Incorp. Has sewers and electric lights.

History.—Put in operation July, '88, by town. Contrs., Union Iron Works, Chattanooga, Tenn.

Water Supply.—Two artesian wells, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 216,000 galls.; Gordon & Maxwell.

Stand-Pipe.—Cap., 360,000 galls.; 30 x 100 ft.

Tank Failure: Original plan was to pump to tank of w. i., 25 x 30 ft., placed on brick tower 70 ft. high. Dec. 6, '87, tower collapsed before completion, killing four men. Brick pier 6 ft. in diam. was being carried up in center, and circular brick wall outside. Scaffolding between the two was removed before tower was completed, and pier fell, carrying with it outer wall.

Distribution.—*Mains*, 3½ miles. *Services*, not given. Pipe and specials from R. D. Wood & Co., Philadelphia, Pa. *Taps*, 150. *Hydrants*, Mathews, 25. Considerable extensions in '89.

Consumption, 80,000 galls. *Pressure*, not given.

Financial.—Cost, $30,000. Debt, $15,000. Int., 5%. Ann. op. exp., $2,000. Ann. rev.: consumers, $1,000; city, not given.

Management.—Secy. and Treas., Jas. F. Evans. Supt., E. O. Thompson.

TYBEE, (*Savannah P. O.*) *Chatham Co.* (Pop., est., 500.) On Tybee island, 18 miles from Savannah. No sewers or electric lights.

History.—Built in '89 by Tybee Artesian Water, Ice & Lighting Co.; put in operation in June.

Water Supply.—Artesian wells, pumping to tank.

Pumping Machinery.—Dy. cap., not given; from A. J. Corcoran, N. Y. City.

Tank.—Cap., 12,000 galls.; from J. McDonough & Co., Savannah.

Distribution.—*Mains*, 4 and 3-in. galv. i., 1 mile. *Services*, ¾-in. galv. i.

Financial.—Cap. stock, originally, $5,000; can be increased to $20,000.

Management.—Prest., Wm. Kehoe. Secy. and Treas., R. P. Lovell. Supt., Jno. G. Butler.

Water-Works Projected with Fair Prospects of Construction.

CEDARTOWN, *Polk Co.* (Pop., township, 843; est., 2,500.) Is 20 miles from Rome. Engaged in trade and iron manufacturing.

Proposed Works.—First part '89 town voted to allow some Co. to build works, withholding right to purchase same after completion. Mar. 1, '90, nothing had been done, and town was still open for propositions.

CORDELE, *Dooly Co.* (Pop. est., 1,500.)

Proposed Works.—Artesian well begun in '89 with Ellis Hathaway, Montgomery, Contr. Sept. 10, '89, it was hoped that mains would be laid through town in '90. Latter part of '89 unofficially reported that town had voted in favor of putting in works. Address J. E. D. Shipp.

FORT VALLEY, *Houston Co.* (Pop., 1,277; est., 2,000.) Has manufactories.

Proposed Works.—Fort Valley Water Co. to build in '90. Supply, artesian wells, by pumping, if flowing wells cannot be obtained. Est. cost, $15,000. Address J. D. Marshall. Unofficially reported, Mar., '90, that contract had been let to Jennings & Bamberg, Bamberg, S. C.

GAINESVILLE, *Hall Co.* (Pop. 1,919; est., 5,000.) Summer resort in agricultural and mining district. Incorp. city. No sewers. Has electric lights.

Proposed Works.—Surveys have been made by Jas. L. Johnson, Atlanta, for city. Supply, Cry creek, 3 miles from city, pumping from 10,000,000-gall. impounding reservoir to stand-pipe, 12 x 60 ft. Dam, 200 ft. long at top, 25 at bottom, 10 ft. of water. A 750,000-gall. Worthington comp., dup., proposed. Est. cost, $40,000. Hoped that works will be built in '90. Address Mayor or City Council.

LA GRANGE, *Troup Co.* (Pop., 2,295; est., 3,000.) Manufactures cotton-seed oil, guano and carriages.

Proposed Works.—July 24, '89, city proposed building works. Supply, wells, pumping to stand-pipe or reservoir. City had no debt. Fall of '89 La Grange Water & Electric Light Co. proposed to build. Address E. D. Pitman or W. S. Robson.

MILLEDGEVILLE, *Baldwin Co.* (Pop., 3,870; est., 5,000.) On Oconee river, in cotton district. Has water-power used in manufacturing.

Proposed Works.—Saml. Walker has charter. Supply, springs, by gravity. Est. cost, $30,000. Latest report, about Jan. 1, '90. See MANUAL for '88, p. 271.

NEWNAN, *Coweta Co.* (Pop., 2,006; est., 2,800.) Manufactures machinery, cotton-seed oil and guano.

Proposed Works.—Co. to build, if at all, as town charter forbids incurring such expense. No further data. Date report, Oct. 10, '89.

TALLAPOOSA, *Haralson Co.* (Pop., 52; est., 2,600.) In iron, timber and farming section.

Proposed Works.—Woltman, Keith & Co., 11 Wall St., N. Y. City, propose to build, from April 15 to Aug., '90. Pumping to stand-pipe. Est. cost, $50,000. Date report, Mar. 17, '90.

TRENTON, *Dade Co.* (Pop.. 225; est., 300).

Proposed Works.—Gravity supply from springs on mountain. Nothing definitely decided Jan 6, '90. Address J. P. Bond.

WASHINGTON, *Wilkes Co.* (Pop., 2,199; est., 3,000.) In cotton and grain section.

Proposed Works.—City tried in '88 to get bill through Legislature authorizing issue of bonds for works. Sept. 24, '89, attempt had not yet been successful, and project was postponed till '90. Unofficially reported Mar., '90, that project was still alive. Supply, springs, pumping to stand-pipe. Est. cost, $25,000 to $30,000. See MANUAL for '88, p. 271. Address T. Burwell Green.

WAY CROSS, *Wave Co.* (Pop., 1,440; est., 4,000.) Manufactures lumber and trades in naval stores.

Proposed Works.—Jan. 4, '90, city had recently voted to issue $30,000 of bonds. Supply, deep well, by pumping. Engr.-in-charge of surveys, H. W. Reed. Chn., H. Murphy.

WAYNESBOROUGH, *Burke Co.* (Pop., 1,008; est., 2,500.)

Proposed Works.—W. A. Wilkins has artesian well with dy. yield of about 100,000 galls. March 8, '90, he stated that village wished him to keep a 6,000-gall. tank full, from which pipes would extend for general supply to village. Work was to begin March 15 and be finished May 1. Est. cost, $3,000.

Water-Works Projects Reported in '89 and '90, but now Indefinite.

Abbeville, Wilcox Co. *Covington*, Newton Co. *Darien*, McIntosh Co. *Florence*, Stewart Co. *Griffin*, Spalding Co. *Hinesville*, Liberty Co.; see MANUAL for '88, p. 271. *Jacksonville*, Telfair Co. *Lexington*, Oglethorpe Co. *Madison*, Morgan Co. *Marietta*, Cobb Co.; see MANUAL for '88, p. 271. *Valdosta*, Lowndes Co.; see MANUAL for '88, p. 271.

FLORIDA.

Water-Works Completed or in Process of Construction.

FERNANDINA, *Nassau Co.* (Pop.. 2,562; est., 4,000.) On Amelia island and Amelia river, 33 miles from Jacksonville. Has good harbor and considerable trade. Incorp. city. Has electric lights, Thomson-Houston.

History.—Built in '89 by city; put in operation Sept. 12. No Engr. Contrs., Jeter & Boardman Water & Gas Co., Macon, Ga.

Water Supply.—An 8-in. artesian well, pumping to tank.

Pumping Machinery.—Dy. cap., 1,250,000 galls.; comp., cond. *Boilers:* one 50-H. P.

Stand-Pipe.—Cap., 113,000 galls.; 100 ft. high.

Distribution.—(Jan. 23, '90.) *Mains*, 10 to 4-in. c. i , 4 miles. *Services*, galv. i. *Taps*, 80. *Meters*, none. *Hydrants*, kind not given, 53.

Consumption, about 20,000 galls. *Pressure:* Ordinary, 46 lbs. Fire, 100 to 150 lbs.

Financial.—(Jan. 23, '90.) Cost, $34,500. Debt and int., withheld. Ann. op. exp. and rev., not determined.

Management.—Board of Public Works Prest., Geo. R. Fairbanks. Supt., Chas Williams.

JACKSONVILLE, *Duval Co.* (Pop., 7,650; est., 25,000.) On west bank of St. John's river, 25 miles from its mouth, at elevation from 5 to 33 ft. above tide-water. Winter resort, also engaged in lumber and other trade. Incorp. in '57. Has sewers and electric lights.

History.—Built in '79-80 by city. Engr., R. N. Ellis.

Water Supply.—Artesian wells, direct pumping Two 6-in. wells, 500 to 600 ft. deep; a 10-in., 1,020 ft. deep; latter sunk '88-9. Combined dy. flow, in '89, about 4,700,000 galls. Water was first pumped from well 50 ft. in diam. and 31 ft. deep with walls of brick in Portland cem. For first 20 ft. well was through sand, then through 11 ft. of rock. This well yielded 1,200,000 galls. a day and was covered with slate roof.

Receiving Basin.—Octagonal, 50 ft. across, 2 ft. deep; 10-in. pipe from large well extends to center, turns upwards, discharging 10 ft. above surface. A 15-in. terra cotta pipe extends to pump-well, and 15-in. overflow to lake.

Pumping Machinery.—Dy. cap., 4,500,000 galls.; 3,000,000, 1,500,000 com., dup. Worthington.

Stand-Pipe.—*Not in use.* Water for domestic consumption was formerly pumped to this.

Distribution.—*Mains*, c. i., 8½ miles. *Services*, enam, i. *Taps*, 980. *Meters*, 385. *Hydrants*, Coffin, Ludlow, 105.

Consumption, 878,207 galls. *Pressure:* Ordinary, 45 lbs. Fire, 110 lbs.

Financial.—Cost, 117,000. Debt, $100,000. Int., 8%. Ann. op. exp., $9,300. Ann. rev.: consumers, $16,000; city, none.

Management.—Trustees of Sanitary Improvement Bonds. Chn., A. S. Baldwin. Secy., P. McQuinn. Supt., R. N. Ellis. Pumping Engr., E. J. Howard.

LAKE CITY, *Columbia Co.* (Pop., 1,379; est., 2,000.) Center of Sea Island cotton region. Incorp. No sewers or electric lights.

History.—Built in '87-8 by Lake City Water & Light Co. Engr., Noyes S. Collins.

Water Supply.—Lake Isabella, pumping to tank.

Pumping Machinery.—Dy. cap., 500,000 galls; Worthington; 5-in. comp., and 4-in., latter for reserve.

Tank.—Cap., 16,000 galls.; 60 ft. high.

Distribution.—*Mains*, 4 and 6-in., kind not given, 2 miles. *Taps*, 40. *Meters*, not given. *Hydrants*, kind not given, 30.

Financial.—Cost, $20,000. Debt, $10,000. Int., 6%. Ann. op. exp., $250. Ann. rev.: consumers, $720; city, $600. Hydrant rental, $20.

Management.—Prest. and Treas., Noyes S. Collins. Secy., L. Harrison.

MELBOURNE, *Brevard Co.* (Pop., est., 150.) On Indian river.

General Description.—Built in or prior to '89 by individuals, principally for fire protection. Supply, artesian well, giving 23 lbs. pressure, by gravity. About ⅛ mile of pipe and 4 taps Cost, $400. Address E. P. Branch or C. H. Stewart.

OCALA, *Marion Co.* (Pop., 803; est., 2,700). In agricultural section.

History.—Built in '87-8 by Ocala Water Co., under 25-years franchise. Engr., A. E. Boardman, of Jeter & Boardman, Macon, Ga., Contrs.

Water Supply.—Artesian well, pumping to tank.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Worthington dup., high-pressure.

Tank.—Cap., 130,000 galls.; 30 x 25 ft.; on brick masonry tower, 40 ft. high; from R. D. Wood & Co., Philadelphia, Pa.

Distribution.—*Mains*, c. i., 5¾ miles. *Services*, galv. i. Pipe and specials from R. D. Wood & Co., Philadelphia, Pa. *Taps*, 94. *Meters*, 3. *Hydrants*, Mathews, 60. *Valves*, Eddy.

Consumption, 50,000 galls. *Pressure:* Ordinary, 60 lbs.

Financial.—Cost, $75,599. Cap. stock, $50,000. Bonded debt, $35,000. Int., 7%. Ann. op. exp., $2,160. Ann. rev.: consumers, $2,614; city, $3,000. Hydrant rental, $50.

Management.—Prest., A. D. Schofield. Secy., R. L. Anderson. Treas., A. E. Boardman, Macon, Ga. Supt., C. H. Campbell.

ORLANDO, *Orange Co.* (Pop., est., 6,000.) Incorp. No sewers or electric lights.

History.—Built in '87 by Orlando Water Co. Engr., J. Dittmar, Williamsport, Pa. No Contr. for labor.

Water Supply.—Highland lake, direct pumping, and pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 1,000,000 galls. Knowles dup. Two return tubular boilers, of steel, from E. Keeler & Co., Williamsport, Pa.

Stand-Pipe.—Cap., 105,000 galls.; 12 x 125 ft. high; from E. Keeler & Co., Williamsport, Pa.

Distribution.—*Mains*, c. i., 13 miles. *Services*, galv. i. Pipe furnished by Jno. J. Fisher, Allentown, Pa. *Taps*, 300. *Meters*, 100. *Hydrants*, Bailey, 54. *Valves*, Eddy.

Consumption, 150,000 galls. *Pressure:* Ordinary, 50 lbs. Fire, 120 lbs.

Financial.—Cost, $150,000. Cap. stock, $50,000. Bonded debt, $100,000. Int., 6%. Ann. op. exp., $4,000. Ann. rev.: consumers, $4,000; city, $3,200. Hydrant rental, $60 for 50, and $50 for additional. Original cost, $160,000.

Management.—Prest., Geo. W. Lentz. Secy., A. Johnson. Treas., H. Hinckley. Local Mgr., H. W. Greetham

PALATKA, *Putnam Co.* (Pop., 1,616; est., 5,000.) On St. John's river in agricultural region. Incorp. No sewers or electric lights.

History.—Built in '86-7 by Palatka Water-Works Co., under 20-years franchise. Engrs. and Contrs., Wheeler & Parks, Boston. Supplies Palatka Heights, also; pop., 300.

Water Supply.—White Water branch, fed by spring, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; Worthington comp. and single, 1,000,000 each. *Boilers:* two tubular; E. Hodge & Co., E. Boston, Mass.

Stand-Pipe.—Cap., 183,000 galls.; 25 x 50 ft.; from E. Hodge & Co., E. Boston, Mass.

Distribution.—*Mains*, 12 to 4-in. c. i., 8.8 miles. *Services*, ¾-in. enam. w. i. Pipe and specials from R. D. Wood & Co., Philadelphia, Pa.; trenching and pipe-laying by Ferris & Halladay, Jersey City, N. J. *Taps*, 210. *Meters*, Crown, 6. *Hydrants*, Coffin, 70; 4 at Palatka Heights, in place of taps, 6 private. *Valves*, Coffin.

Consumption (in '87), 75,000 galls. *Pressure*, 60 lbs.

Financial.—Cost, $140,000. Cap. stock, $75,000. Bonded debt, $60,000. Int., 6%. Ann. op. exp., $1,600. Ann. int., $3,900. Ann. rev.:. consumers, $4,200; city, $2,970. Hydrant rental, $50.

Management.—Prest., Harvey Wheeler, Concord, Mass. Secy., Jno. Mulhall, 89 State St., Boston, Mass. Treas., Elbert Wheeler, 24 State St., Boston, Mass. Supt., J. H. Yeaton.

PENSACOLA, *Escambia Co.* (Pop., 6,845; est., 15,000.) On Pensacola bay, 6 miles from Gulf of Mexico. Has fine harbor; engaged in lumber and other trade. Incorp. Has sewers and electric lights.

History.—Built in '85-6 by Pensacola Water Co., under 50-years franchise. Engr., C. Delafield, N. Y. City. Contrs., Saml. R Bullock & Co., N. Y. City.

Water Supply.—Artesian wells, pumping to stand-pipe. Wells are 4 ins. in diam., from 175 to 400 ft. deep.

Pumping Machinery.—Dy. cap., 4,000,000 galls.; two Deane comp., cond.

Stand-Pipe.—Cap., 459,000 galls; 25 x 125 ft.; on natural elevation; from Tippett & Wood, Phillipsburgh, N. J.

Distribution.—*Mains*, c. i., 12 miles. *Services*, w. i., lead. Pipe and specials from R. D. Wood & Co., Philadelphia, Pa. *Taps*, 516. *Meters*, 10. *Hydrants*, Pattee & Draper, 103. *Valves*, Pattee & Draper.

Consumption, 1,000,000 galls. *Pressure:* Ordinary, 75 lbs. Fire, 100 lbs.

Financial.—Cost, $150,000. Cap. stock, $150,000. Bonded debt, $150,000. Sinking fund, $2,500 added annually. Int., 6%. Ann. op. exp., $10,000. Ann. rev.: consumers, $9,000; city, $6,150. Hydrant rental, $60.

Management.—Prest., B. B. Pitt. Supt., Secy. and Treas., Ed. Gale Quina.

ST. AUGUSTINE, *St. John's Co* (Pop., 2,293; est., 3,500.) On Bay of St. Augustine. Summer resort. One of oldest towns in U. S., a fort having been built here by Spaniards in 1565.

General Description.—Four artesian wells, 6 and 3-in. mains, 35 hydrants. Address Edw. F. Joyce. No further data.

SANFORD, *Orange Co.* (Pop., 1,300; est., 4,000.) On St. John's river on slightly rolling ground. Settled in '71; incorp. city in '76. No sewers or electric lights.

History.—Built in '83 by Sanford Water-Works Co., under 50-years franchise. Des. Engr., Terrell & Muckle. Const. Engr., Wm. Beardall, present Supt.

Water Supply.—Island lake, by gravity to reservoir, thence by direct pumping. Lake is fed by springs; area, 40 acres. Water formerly pumped from reservoir to two wooden tanks. See MANUAL for '88.

Reservoir.—Cap., 250,000 galls.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; 1,200,000 and 300,000. Worthington. *Boilers:* from Wm. Bates & Son, Conshohocken, Pa.

Distribution.—*Mains*, c. i., 4½ miles. *Services*, enam. i. Pipe and specials from R. D. Wood & Co., Philadelphia, Pa. *Taps*, 300. *Meters*, 10. *Hydrants*, from Orlando Foundry, 40. *Valves*, Eddy.

Consumption, 125,000 galls. *Pressure*, 35 lbs.

Financial.—Cost, $51,000. Cap stock, $40,000. Bonded debt, $20,000. Int., 6%. Ann. op. exp., $2,700. Ann. rev.: consumers, $3,300; city, $1,650. Hydrant rental, $50.

Management.—Prest., H. S. Sanford. V. Prest., F. H. Rand. Secy. and Supt., W. Beardall.

SEVILLE, *Volusia Co.* (Pop., est., 500.) In timber and orange country. Has sewers.

History.—Built in '86 by Seville Co., incorp. July 15, '85, for general purpose of dealing in and improving lands, lots and town sites. Water-works and sewerage systems are operated together. Engr., Jas. J. Powers, Brooklyn. All work done by Co.

Water Supply.—Lake Louise, pumping to tanks. Lake has hard, sandy bottom, is fed by subterranean springs, and is ½ x 2¼ miles.

Pumping Machinery.—Dy. cap., 200,000 galls.; Deane dup.

Tanks.—Cap., 53,000 galls.; two, on 50-ft trestle.

Distribution.—(In '87.) *Mains*, 4 to 10-in., kind not given, 1½ miles. *Taps*, withheld, est., 50. *Meters*, not given. *Hydrants*, kind not given, 8.

Consumption, not given. *Pressure:* by gravity from tanks, 22 lbs.; pumping through tanks, 45 to 50 lbs.; direct pumping, 180 lbs.

Financial.—Cost, withheld, est., $10,000. Cap. stock of Co., $50,000. No bonds. Ann. op. exp., withheld, est., $700. Ann. rev., withheld, est., $2,000.

Management.—(In '88.) Prest., Mason Young, 35 Wall St., N. Y. City. Secy. and Treas., R. H. Mason.

TAMPA, *Hillsborough Co.* (Pop., 720; est., 3,000.) On Tampa bay with good harbor. Has cigar manufactories.

History.—Built in '88-9 by Tampa Water-Works Co., under a 30-years franchise. Engr., A. E. Boardman, of Jeter & Boardman Gas & Water Assoc., Macon, Ga., Contrs.

Water Supply.—Artesian well, pumping to tank. Large spring, flowing 5,500,000 galls. dy.; was bought in '89, and connected with present works by 1,000 ft. of 10-in. pipe.

Pumping Machinery.—Dy. cap., 1,500,000 galls; two Worthington dup., high-pressure.

Tank.—Cap., 111,000 galls.; 30 x 21 ft., placed on tower 100 ft. high; from R. D. Wood & Co., Philadelphia, Pa.

Distribution.—*Mains*, c. i., 12 miles. *Services*, galv. i. Pipe and specials from R. D. Wood & Co., Philadelphia, Pa. *Taps*, withheld, est., 400. *Hydrants*, Mathews, 110. *Valves*, Eddy.

Consumption, 120,000 galls. Pressure, 50 lbs.

Financial.—Cost, $142,000. Cap. stock, $100,000. Bonded debt, $82,000. Sinking fund, 10% of net earnings. Int., 6%. Ann. rev.: consumers, withheld, est., $8,500; city, $4,950. Hydrant rental, $45.

Management.—Prest., J. S. Schofield. Secy., W. J. Allen. Treas., A. E. Boardman, Macon, Ga. Supt., W. A. Campbell.

Water-Works Projected with Fair Prospects of Construction.

DE LAND, *Volusia Co.* (Pop., est., 2,400.) On St. John's river, in agricultural and fruit-raising section. Incorp. No sewers. Has electric lights.

Proposed Works.—In '86 contract for water-works was made with A. A. Parker, but never fulfilled. In '87 contract was let for artesian well, which in Nov., 88, had been sunk 465 ft. through rock, and yielded water within pumping distance of the surface. Owing to yellow fever in fall of '88 all work was abandoned. In '89 plans were made, providing for pumping to stand-pipe. Est. cost, $30,000. Proposed to build in '90. City Clerk, Silas B. Wright. Latest report, Jan., '90.

GAINESVILLE, *Alachua Co.* (Pop., est., 4,500.) Engaged in agriculture and orange growing.

Proposed Works.—City to sink artesian well in '90; if flowing well is not secured water will be pumped to stand-pipe. Money to be raised by taxation. Attempts to build works have been made for two or more years. Address B. C. Drake. Date report, Mar. 5, '90.

KEY WEST, *Monroe Co.* (Pop., 9,890; est., 20,000.) On Gulf of Mexico. Engaged in shipping and various manufactories.

Proposed Works.—June 22, '89, Key West Water Supply Co. proposed to sink in. artesian well, from which water would be pumped. No later data could be tained. Prest., Geo. W. Parker, St. Louis, Mo. Report by W. C. Maloney.

KISSIMMEE, *Osceola Co.* (Pop., est., 1,400.) On Lake Tohopekaliga, 18 miles from Orlando. Raises oranges and early vegetables.

Proposed Works.—Kissimmee Water Co. chartered in '88, but had done nothing May 8, '89. Unofficially reported latter part of '89 that Kissimmee Ice Co. proposed to build works. Address C. Swayne, or either of above Cos.

LIVE OAK, *Suwannee Co.* (Pop., 458; est., 1,000.) In agricultural section.

Proposed Works.—Artesian well has been sunk 1,500 ft., unsuccessfully. Jan., '90, resident stated that another attempt would be made.

TALLAHASSEE, *Leon Co.* (Pop., 2,494; est., 3,500.) In farming and fruit raising district

Proposed Works.—May 6, '89, Tallahassee Water-Works Co. reported that they would begin construction Aug. 1, '89. Supply, spring or wells, pumping to stand-pipe. About 6 miles mains, 60 hydrants. Cap. stock, $50,000. Bonds, authorized. $40,000. Hydrant rental, total of $2,400 per year expected. Prest., R. L. Bennett. Secy. and Treas., G. W. Saxon.

Aug., '89, unofficially reported that American Pipe Co. had contract for construction, and that works would be completed middle of '90.

Water-Works Projects Reported in '89 and 90, but now Indefinite.

Eustis, Lake Co. *Green Cove Springs*, Clay Co. *Leesburgh*, Lake Co.

GROUP 4.—Gulf and Mississippi Valley States.—Water-Works Completed, in Process of Construction or Projected, in Alabama, Mississippi, Louisiana, Tennessee and Kentucky.

ALABAMA.

Water-Works Completed or in Process of Construction.

ANNISTON, *Calhoun Co.* (Pop., 942; est., 10,000.) On Snow's creek, on rolling land in valley; in coal and iron region. Engaged in iron and other manufacturing. Settled in '72; incorp. town in '79. Has sewers and electric lights.

ANNISTON CITY LAND CO.'S WORKS.

History.—Built in '80-1 by Woodstock Iron Co., and now owned by Anniston City Land Co. Contrs., Noble Bros. & Co., Anniston.

Water Supply.—Artesian well, pumping to stand-pipe. Water was first taken from well 10 ft. in diam., 60 ft. deep, cased with c. i. made in segments and settled as well was sunk. Ground at the top of well was 50 ft. below lowest part of town, and 220 ft. below top of tank.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; 16 x 48-in pump, driven by beam engine made by Noble Bros. & Co., Anniston; also one dup., direct acting, Deane.

Tank.—Cap., 375,000 galls.; plate-iron, 40 x 40 ft.; on stone foundation.

Distribution.—*Mains*, c. i., 8 miles. *Services*, w. i. *Taps*, 280. *Meters* 25. *Hydrants*, Chapman, Matthews, 56.

Consumption, 450,000 galls. *Pressure*, 90 to 97 lbs.

Financial.—Cost withheld, est., $100,000. No debt. Ann. op. exp., withheld, est., $2,000. Ann. rev.: consumers, $6,750; city, $1,650. Hydrant rental, $50. Original cost, 50,000.

Management.—Prest., Jno. M. McKleroy. Secy. and Treas., Wm. Davis. Supt., H. B. Rudisill.

ANNISTON WATER SUPPLY CO.'S WORKS.

History.—Built in '89-90, under franchise granted to T. G. Bush, Mobile. Engr., Jno. H. Turner. Construction began Oct. 1, '89; to be finished on or near May 1, '90.

Water Supply.—Springs, pumping to reservoir.

Pumping Machinery.—Dy. cap., 8,000,000 galls.; two 4,000,000 Gaskill. *Boilers:* Holly.

Reservoir.—Cap., 10,000,000 galls.; 223 ft. above city. Contr., H. Merigold.

Distribution.—*Mains*, c. i , 15 miles. Pipe and specials from Anniston Pipe Foundry; laid by H. Merigold. *Hydrants*, Mathews, 100. *Valves*, Eddy.

Financial.—Bonds, $300,000; due in 1919. Int., 6%. Ann. rev.. consumers, Woodstock Iron Co. has contracted for water for 10 years at $6,000, Anniston Pipe Co., do., 20 years at $5,000. Hydrant rental, $50; 20-years contract.

Management.—Prest., T. G. Bush, Mobile. Secy. and Treas., T. E. Smith. Supt., H. E. Rudisell.

NOTE.—Above report made Jan. 20, '90, before completion of works.

BESSEMER, *Jefferson Co.* (Pop., est , 3,500.) Manufacturing town, 12 miles from Birmingham, between the two largest coking coal fields in the district, close by iron ore deposits, and on limestone formation. Has blast furnace, rolling mill, and other manufactories. Incorp. Has sewers and electric lights.

History.—Built in '87-8 by Bessemer Land & Improvement Co. Des. Engr., B. B. Gordon. Contrs., Scovel & Irwin, Nashville, Tenn.

Water Supply.—Two small spring-fed streams, by gravity to pump-pond, thence by pumping to stand-pipe. Est. min. dy. flow, 2,000,000 galls.

Dams and Reservoirs.—Cap., 8,000,000 galls.; 5,000,000 and 3,000,000. Dams not described.

Pump-Pond—Diam., 100 ft.; depth, 6 ft.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two 1,000,000 Blake dup. *Boilers:* two 45-H. P. Babcock & Wilcox.

Stand Pipe.—Cap., 235,000 galls.; steel, 20 x 100 ft.; on elevation.

Supply Main.—From stand-pipe to town, about one mile of 12-in. c. i.

Distribution.—*Mains*, c. i., 10 miles. *Services*, w. i., lead. Pipe and specials from South Pittsburgh (Tenn) Pipe Works. *Taps*, 150. *Meters*, none. *Hydrants*, Bourbon, 45. *Valves*, kind, do.

Consumption, 1,300,000 galls., a large proportion being taken by manufactories. *Pressure:* Ordinary, 45 lbs. Fire, 90 lbs.

Financial.—Cost, $98,000. No debt. Ann. op. exp., $5,000. Ann. rev.: consumers, withheld, est., $12,000; city, $500.

Management.—Prest., W. A. Courtenay. Secy. and Treas., H. M. McNutt. Genl. Agt., Geo. M. Wells.

BIRMINGHAM, *Jefferson Co.* (Pop., 3,086; est., 42,000.) In coal and iron region; engaged in manufacturing.

History.—Built in '72-3 by the Elyton Land Co.; extended since, and now owned by Birmingham Water-Works Co. Engr. of original works, Travers Daniel. Des. Engr. of improvements, W. S. Milner; Const. Engr., J. S. Walker. See Additional Supply, below.

Water Supply.—Five Mile creek through a canal 7 miles long to settling basin, thence by pumping to reservoir. Available dy. supply, 5,000,000 to 6,000,000 galls. See Additional Supply, below.

First supply from Village creek; drainage area, 30 to 40 sq. m. of limestone formation; dy. flow at low water, about 35,000 galls.

Canal.—Is 7 miles long.

Settling Basin.—No data.

Pumping Machinery.—Dy. cap., 9,500,000 galls.; three comp., dup , 6,000,000 Deane, two Blake. First pump was a 750,000 Worthington, lifting water 150 ft.

Reservoir.—Cap., 4,000,000 galls. First distributing reservoir had cap. of 1,000,000 galls., in excavation and embankment, lined with brick in cem., had round corners, and slopes of 1½ to 1; 95½ x 150½ ft. at top, 58 x 113 ft. at bottom, 12½ ft. deep. To '81 it had leaked badly from time to time.

Distribution.—*Mains*, c. i.. 40 miles. *Services*, w. i. *Taps*, 2,361. *Meters*, 334 *Hydrants*, Ludlow, Williams, 60. *Valves*, Ludlow, Chapman, Eddy. *Close of '86*: Mains, 25.32 miles. Taps, 1,527. Meters, 80. *Do.*, '87: Mains, 30.38. Taps, 2,044. Meters, 250.

Consumption, 4,250,000 galls. *Pressure*, 50 lbs.

Financial.—Cost, $781,170. Debt, $300,000. Int., 6%. Ann. op. exp., $21,000. Ann. rev.: consumers, $73,829; city, $7,000. Hydrant rental, $55. Cost, '86, about $400,000; '87, $606,387. Rev., '86, $49,029; '87, $71,879.

Management.—H. M. Caldwell. Secy. and Supt., W. J. Milner. Treas.. Jno. Loudon.

ADDITIONAL SUPPLY.

General Description.—June 2, '88, contract was made with city to furnish additional supply. In '89 work was in progress. Contrs.: pump, H. R. Worthington

N. Y. City; reservoir tunnel and ditch, Dunn Bros., Columbus, Miss.; pipe, Dennis Long & Co., Louisville, Ky. Water will be pumped from Cahaba river, 7¾ miles from city, through two 20-in. mains to stand-pipe 425 ft. above and about 2,700 ft. from river. Thence it will flow to reservoir about midway between pump and city through 30-in. main; latter will also pass around reservoir and connect with 30-in. supply main to city, making direct pumping possible. Supply main will pass through tunnel 2,100 ft. long. These works will give additional supply of about 10,000,000 galls., which can be increased. Est. cost, $450,000.

COLUMBIA, *Henry Co.* (Pop., 290; est., 1,200.) On Chattahoochee river, in cotton district. Incorp. city.

History.—Built in '89-90 by city. **Water Supply.**—Artesian well, pumping to tank. **Pumping Machinery.**—Dy. cap., about 100,000 galls. **Tank.**—Cap., 50,000 galls.; 75 ft. high. **Management.**—City Council. Mayor, M. S. Smith.

NOTE.—Above from J. F. Kuerber, about Sept. 10, '89. Mar., '90, resident wrote "we have built no works yet. Don't know when we shall." Unofficially reported in Mar. that Town Council had taken steps to ascertain cost of works.

DECATUR, *Morgan Co.* (Pop., 1,063; est., 12,000.) On Tennessee river, in iron region; has large iron and car manufactories. Incorp. Has sewers and electric lights.

History.—Built in '88-'9 by Decatur Water Co., under 25-years franchise. Engrs. and Contrs., Howland & Ellis, Boston, Mass. Supplies New Decatur, office, pumping station and stand-pipe being in new town.

Water Supply.—Tennessee river, pumping to stand-pipe or direct.

Intake Pipe.—Laid by Thacher & Breyman, Toledo, O.

Pumping Machinery.—Dy. cap., 5,000,000 galls.; two 2,500,000 Deane dup., direct-acting. *Boilers:* from Wm. Allen & Sons, Worcester, Mass.

Stand-Pipe.—Cap., 270,000 galls.; 20 x 120 ft.; from Tippett & Wood, Phillipsburgh, N. J.

Distribution.—*Mains*, c. i., about 41 miles. *Services*, galv. i. Pipe and specials from Dennis Long & Co., Louisville, Ky, *Taps*, not given. *Meters*, Frost, 20. *Hydrants*, Chapman, 400. *Valves*, Chapman.

Consumption, 300,000 galls. *Pressure:* Ordinary, 55 lbs. Fire, 100 lbs.

Financial.—Cost, $650,000. Cap. stock, $350,000. Bonded debt, $300,000 Int., 6%. Ann. op. exp., $12,175. Ann. rev.: consumers, $34,160; city, $13,550. Hydrant rental, $50 for first 100, $40 for second and $30 for additional.

Management.—Prest., Jno. D. Roquemon. Secy., W. F. Ellis. Treas., C. C. Harris. Genl. Mgr., A. H. Howland, Boston, Mass.

EUFAULA, *Barbour Co.* (Pop., 3,836; est., 5,000.) On Chattahoochee river. Incorp. No sewers. Has electric lights.

History.—Built in '87-8 by Eufaula Water Co., under 20-years franchise. Engrs. and Contrs., Howland & Ellis, Boston, with Geo. A. Ellis in charge.

Water Supply.—Little Chewalla creek and Shorter Springs branch, pumping from storage reservoir to stand-pipe. Dy. flow in dry weather, 1,000,000 galls.

Filter.—Is 20 ft. sq., water passing through about 2 ft. of sand and gravel to storage reservoir.

Reservoir.—Cap., 570,000 galls.; 64 x 159 ft., 11 ft. deep. A 10-in. conduit leads to pump-well.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two Davidson single plunger, cond. or non-cond., 10 x 20-in. cylinders, 10-in. plungers. *Boilers:* two 90-H. P. tubular, 5 x 16 ft.

Stand-Pipe.—Cap., 278,600 galls.; 26 ft. x 70 ft. high; between pumps and town, with top 143 ft. above business part of city.

Distribution.—*Mains*, c. i., w. i. and cem., 10 to 4-in., 6½ miles. *Services*, w. i. *Taps*, not given, est., 100. *Meters*, none. *Hydrants*, Coffin, 50. *Valves*, Coffin.

Consumption, 150,000 galls. *Pressure*, 75 lbs.

Financial.—Cost, $60,000. Debt, $60,000. Int., 6%. Ann. op. exp., $2,500. Ann. rev.: consumers, withheld, est., $2,000; city, $3,000. Hydrant rental, $60.

Management.—Prest., S. H. Dent. Secy. and Treas., E. B. Young. Supt., R. H. Walker.

FLORENCE, *Lauderdale Co.* (Pop., est., 4,000.) On Tennessee river at head of navigation. Incorp. No sewers. Has electric lights.

CYPRESS WATER-WORKS CO.

History.—Built in '87 under 20-years franchise. Des. Engr., Chas. Boech, Atlanta, Ga. Const. Engr. and Contr., Wm. H. Brundige, Florence. Sub-contrs. for masonry, Mills & Storey; buildings, J. W. Nichols & Co. Both of Florence.

In '89 Jeter & Boardman Water & Gas Assn., Macon, Ga., bought these works; they will be combined with new plant, described below.

Water Supply.—Cypress creek, pumping to reservoir.

Pumping Machinery.—Dy. cap., 400,000 galls.; Blake dup. *Boiler:* upright, steel.

Reservoir.—Cap., 94,000 galls.: 30 x 18 ft.; Contrs., J. W. Nichols & Co., Florence.

Distribution.—*Mains*, 4 and 6-in. c. i., 3 miles. *Services*, w. i. Pipe and specials from South Pittsburgh (Tenn.) Pipe Works. *Taps*, 125. *Meters*, none. *Hydrants*, Ludlow, 18. *Valves*, Ludlow.

Consumption, 50,000 galls. *Pressure*, 35 lbs.

Financial.—Cost, $12,000. Cap. stock, $10,000. No debt. Ann. op. exp., $300. Ann. rev.: consumers, $1,200; city, $900. Hydrant rental, $50.

Management.—Prest., A. Brown. Secy., J. D. White. Supt., W. H. Brundige.

NEW WORKS.

History.—Built in '89-90 by Jeter & Boardman Water & Gas Assn. Des. Engr., A. E. Boardman, Macon, Ga. Contrs., above Co.

Water Supply.—Source not given, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 3,000,000 galls.: two 1,500,000 Worthington. *Boilers:* two 100-H. P.

Stand-Pipe.—Cap., 400,000 galls.; 24 x 120 ft.

Distribution.—*Mains*, 16 to 6-in., 13 miles. *Hydrants*, 100.

Financial.—Hydrant rental, $45 each for 30 years; afterwards, $40.

Management.—Supt., Wm. H. Brundige.

NOTE.—Above subject to change, as works will not be completed till latter part of '90.

FORT PAYNE, *De Kalb Co.* (Pop., est., 6,000.) Incorp. city. No sewers. Has electric lights.

History.—Built in '89 by Fort Payne Coal & Iron Co.: put in operation July 26. Engrs., Nier, Hartford & Mitchell. Contr., E. Sutphin. All of Kansas City, Mo.

Water Supply.—Two springs, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 1,800,000 galls.; Deane dup. *Boilers:* Rohan Bros., St. Louis, Mo.

Stand-Pipe.—Cap., 263,000 galls.; 30 x 50 ft; from Ripley & Bronson, St. Louis, Mo.

Distribution.—*Mains*, 10 to 4-in. c. i., 5 miles; from Chattanooga (Tenn.) Foundry and Pipe Works. *Taps*, 170. *Meters*, 9. *Hydrants*, Chapman, 60.

Pressure: Ordinary, 85 lbs. Fire, 120 lbs.

Financial.—Cost, $65,000.

Management.—Prest., J. W. Spaulding. Secy., C. O. Godfrey. Treas., F. H. Foby. Supt., Z. S. Spaulding. Latest report, Sept. 22, '89.

GADSDEN, *Etowah Co.* (Pop., 1,697; est., 5,000.) On Coosa river, in iron and coal, cotton and grain region. Has manufactories.

History.—Built in '85-6 by Gadsden Water-Works Co., under a 20-years franchise. Engr., S. H. Lockett, N. Y. City.

Water Supply.—Coosa river, pumping through filter to reservoir.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Deane.

Filter.—Dy. cap., 325,000 galls.; erected Nov., '87; Hyatt.

Reservoir.—Cap., 1,800,000 galls. Unofficially reported as 128 x 190 ft. at top, 38 x 98 ft. at bottom, 18 ft. deep, 2,000 ft. from and 200 ft. above pumps, 137 ft. above town.

Distribution.—(In '87.) *Mains*, c. i., 6½ miles. *Services*, w. i. *Taps*, 175. *Meters*, none. *Hydrants*, Ludlow, 50. *Valves*, Ludlow.

Consumption, not given. *Pressure*, 65 lbs.

Financial.—(In '87.) Cost, $62,000. Cap. stock, $13,000. Bonded debt, $42,000 Int., 8%. Ann. op. exp., $1,500. Ann. rev.: consumers, $2,100; city, $3,750. Hydrant rental, $75.

Management.—Prest., A. L. Glenn. Supt., M. E. Jones.

NOTE.—No reply to inquiries sent in '89.

HUNTSVILLE, *Madison Co.* (Pop., 4,977; est., 7,000.) On western foot hills of Cumberland mountains. Has various manufactories. Settled about '13. Incorp. Has sewers and electric lights.

History.—Built in '25, now owned by city. In '25, bored logs were laid from large spring to public square, 400 ft. Spring issues from a limestone bluff 40 ft. high, and is on land then owned by Dr. Thomas Fearn, who, in '36, agreed with City Council to build jointly with them a reservoir above spring; he put in turbine wheel and pump, laid pipes, and collected water rents. In '58 town purchased works and springs for $10,000.

Water Supply.—Spring, with dy. flow of 2,000,000 galls., pumping to reservoir.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Gordon & Maxwell comp., cond. First pump was driven by turbine. In '69 Worthington was added to supplement water-power pump, and both have since been replaced by above.

Reservoir.—Cap., 200,000 galls.; 60 ft. in diam., 30 ft. above spring.

Distribution.—*Mains*, 12 to 4-in. c. i., 9 miles. *Services*, w. i. *Taps*, 740. *Meters*, none. *Hydrants*, kind not given, 42.

Consumption, 800,000 galls. *Pressure*, 40 lbs.

Financial.—Cost, withheld, est., $75,000. Bonded debt, $15,000. Int., 6%. Ann. op. exp., $2,800. Ann. rev.: consumers, $4,000. Hydrant rental, $8.

Management.—City Council. Chn., S. J. Mayhew.

JACKSONVILLE, *Calhoun Co.* (Pop., 882; est., 2,000.) A summer resort in an agricultural region.

History.—Built in '83 by town. Engr., Jno. H. Farney. In '89 it was unofficially reported that works had been bought by Chas. Martin.

Water Supply.—Springs on mountain, by gravity to and from reservoirs.

Reservoir.—Cap., 1,000,000 galls.

Distribution.—(In '87.) *Mains*, 4-in., kind not given, 4 miles. *Services*, not given. *Taps*, 200. *Meters*, none. *Hydrants*, kind not given, 30.

Consumption (in '87), said to be 500,000 galls. *Pressure:* Ordinary, 70 lbs. **Fire,** 110 lbs.

Financial.—(In '87.) Cost, $40,000. Bonded debt, $20,000. Int., 5%. Ann op. exp., $1,800. Ann. rev.: consumers, $3,000; city, $3,000. Hydrant rental, $45.

Management.—(In '88.) City Council. Supt., D. J. Privett. See History.

NOTE.—No reply to inquiries sent in '89.

MOBILE, *Mobile Co.* (Pop., 29,132; est., 40,000.) On Mobile river, near its entrance to Mobile bay, on level, sandy plain about 15 ft. above tide. Engaged in commerce and manufacturing. Incorp. No sewers. Has electric lights.

THE MOBILE WATER-WORKS CO.'S SYSTEM.

In '40 works were built by ——— Stein, who contracted to supply city with water for 20 years, after which city was to buy works. No just settlement was made at end of that time, and works go under above name, although owned by Louis Stein, son of builder.

In '86-8 the Bienville Water Supply Co. built works under State charter, and after their completion the Mobile Water-Works Co. brought suit, claiming exclusive right to supply city with water. Supreme Court decided adversely.

General Description.—No data has been given by this Co. since '85, when water was pumped from Three Mile creek and spring to stand-pipe by double-acting horizontal 10 x 48-in. pump, made by the West Point (N. Y.) Foundry Co., driven by two 16-ft. breast-wheels; also by Blake comp. condensing pump of 14 and 24-in. steam, 14-in-water cylinders, 24-in. stroke. In '85 there were 22 miles of 10 to 3-in. c. i. pipe, 150 hydrants, one meter and 1,200 taps. Service pipes were of lead. Works had cost $200,000, and the yearly operating expenses were $8,000. Louis Stein was then Supt.

BIENVILLE WATER SUPPLY CO.'S SYSTEM.

History.—Built in '86-8. Engr , C. Delafield. Contr., Saml. R. Bullock. Both of N. Y. City.

Water Supply.—Clear creek, pumping direct or to reservoir.

Pumping Machinery.—Dy. cap., 12,000,000 galls.; two 6,000,000 comp., cond. Gaskill.

Reservoir.—Cap., est., 4,000,000 galls.; 300 ft. in diam. at top, 20 ft. deep.

Distribution.—*Mains*, c. i., 36 miles. *Services*, w. i., lead. Pipe and specials from McNeal Pipe & Foundry Co., Burlington, N. J., and Florence Iron Works, Philadelphia, Pa. *Taps* (in '87), 527. *Meters*, 12. *Hydrants*, Ludlow, 260. *Valves*, Ludlow.

Consumption, not determined. *Pressure*, 85 lbs.

Financial.—Cost, $1,250,000. Cap. stock, $500,000. Bonded debt, $750,000. Int. 6%. Ann. op. exp. and rev., not given for '88. Hydrant rental, $50.

Management.—Prest., Geo. A. Ketchum. Secy., A. P. St. John. Treas., W. Wood. Supt., Jno. H. Turner. Gen. Supt., A. W. MacCullum, 400 Chestnut St., Philadelphia, Pa.

MONTGOMERY, *Montgomery Co.* (Pop., 16,713; est., 35,000.) On Alabama river at head of navigation, on high bluff. High water in river is 162 ft. above Gulf of Mexico. Has manufactories. Laid out in '17. Incorp. Has sewers and electric lights.

History.—Built in '73 by Montgomery Water-Works Co. In '80 works and franchises were bought by Geo. H. Hazlehurst and associates and reorganized as the Montgomery Water-Works. From start system was inadequate, and Oct. 7, '85, City Council contracted with A. H. Howland, Boston, for construction and maintenance of new system. Capital City Water Co. was organized, and works built in '86-7, with A. H. Howland as Engr. and Contr. Franchise, 20 years.

Supply for old works was pumped from Alabama river through 10-in. main to city distribution, surplus going to reservoir 1½ miles from pump, 184 ft. above mean low water in river, and at an av. elevation of 100 ft. above business portion of town. At first water was taken directly from river throughout year, but later a filter was constructed for use when water was muddy. There was a 1,000,000 Worthington pump, located in pump-well, with boilers above. Reservoir had cap. of 4,000,000 galls., was in embankments, with inner slopes 2 to 1, and outer, 1½ to 1; with a promenade 20 ft. wide on top of banks.

In '81 there were about 10 miles of 10 to 3-in. c. i. mains, 100 hydrants and 550 private consumers. New works are described below.

Water Supply.—Artesian wells, discharging into reservoirs, thence by pumping through distributing mains to stand-pipe. In '86 there were six 8-in. wells having dy. cap. of 5,000,000 galls. Two were 635, two 543, and two 280 ft. deep, each pair of wells taking water from different stratum, but quality of water in each being same.

Reservoir.—Cap., 3,500,000 galls.; in embankments lined with masonry and divided by masonry wall into two compartments.

Pump House.—Brick, with iron truss roof, two stories high; 80 x 50 ft., with smoke stack 105 ft. high, having 25 ft. of flue area. Building fireproof.

Pumping Machinery.—Dy. cap., 8,000,000 galls.; Deane; 2,500,000 comp., dup., direct-acting; cond., 2,500,000 dup., direct-acting high-pressure. *Boilers:* Six 80-H. P., steel; from Wm. Allen & Sons, Worcester, Mass.

Stand-Pipe.—Cap., 417,000 galls.; w. i., 26 x 105 ft.; 250 ft. above high water in river; from Tippett & Wood, Phillipsburgh, N. J.

Distribution.—*Mains*, c. i., 42 miles. *Services*, galv. i., lead. Pipe and specials from Warren Foundry & Machine Co., Phillipsburgh, N. J., and Chattanooga (Tenn.) Foundry & Pipe Works. *Taps*, 1,735. *Meters*, Frost, 600. *Hydrants*, Coffin, 275. *Valves*, Coffin. *Pressure-recording gauge*, Edson.

Consumption, 1,250,000 galls. *Pressure*, 110 lbs.

Financial.—Cost, $697,000. Cap. stock, $350,000. Bonded debt, $345,000. Int., 6%. Ann. op. exp., $17,500. Ann. rev.: consumers, $36,131; city, $125,000. Hydrant rental, $55.

Management.—Prest., J. W. Dimmick. Secy. and Supt., F. Crosby. Treas. and Gen. Mgr., A. H. Howland, Boston.

NEW DECATUR, *Morgan Co.* See Decatur.

SELMA, *Dallas Co.* (Pop., 7,529; est., 12,000.) On Alabama river, in cotton district; center of cotton, lumber, iron and coal trade. Incorp. Has sewers and electric lights.

History.—Built in '86 by Selma Water Co., under 30-years franchise. Des. Engr., Wm. H. White, N. Y. City. Const. Engr., C. A. White, St. Paul, Minn.

Water Supply.—Artesian wells, pumping to stand-pipe and direct.

Reservoir.—Is 14 x 174 ft., probably receives water from wells.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Worthington.

Stand-Pipe.—Cap., 159,000 galls.; 15 x 120 ft.; from Tippett & Wood, Phillipsburgh, N. J.

Distribution.—*Mains*, c. i., 13 miles. *Services*, galv. i. Pipe and specials from Chattanooga (Tenn.) Foundry & Pipe Co.; trenching and pipe-laying done by C. A. White, St. Paul, Minn. *Taps*, 400. *Meters*, none. *Hydrants*, Ludlow, 107. *Valves*, Ludlow.

Consumption, 2,000,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—Cost, not given, est., $170,000. Cap. stock, $122,000. Bonded debt, $100,000. Int., 6%. Ann. op. exp., $4,000. Ann. rev.: consumers, $6,000; city, $6,000. Hydrant rental, $65 for 85, $45 for additional.

Management.—Prest., W. H. White, 32 Pine Street, N. Y. City. Secy., S. W. John. Treas., J. E. Fuller. Supt. and Pumping Engr., Thos. K. Gatchell.

SHEFFIELD, *Colbert Co.* (Pop., est., 3,000.) A new town. No sewers. Has electric lights.

TEMPORARY WORKS.

General Description.—Built prior to '88 by Sheffield Land, Iron & Coal Co., who formerly owned town site. Engr., Chas. Boeckh, Atlanta. Water pumped from Tennessee river. Mains, about 10 miles. Water was supplied free. Cost, $10,000. Distribution included in new plant, described below.

SHEFFIELD WATER COMPANY'S WORKS.

History.—Built in '89-90, under 30-years franchise. Stock all indorsed and largely owned by Sheffield Land, Iron & Coal Co. Engrs. and Contrs., Scovell & Irwin Construction Co., Nashville, Tenn.

Water Supply.—Tennessee river, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 4,000,000 galls.

Stand-Pipe.—Cap., 188,000 galls.; 20 x 80 ft.

Distribution.—*Mains*, est., 20 miles. *Hydrants*, about 100.

Financial.—Cost, est., $100,000. Cap. stock, authorized, $250,000. Bonded debt, authorized, $250,000; issued, $100,000.

Management.—Prest., W. L. Chambers. Secy. and Treas., J. V. Allen.

NOTE.—Above subject to revision, as latest report was made in Sept., '89.

SPRING GARDEN, *Cherokee Co.* (Pop., est., 300.) Not incorp. No sewers or electric lights.

History.—Built in '89 by Spring Garden Water-Works, Land and Improvement Co., under direction of J. W. Tucker; put in operation Oct. 1.

Water Supply.—Glade Springs, pumping to reservoir. Springs, 3,052 ft. from the main street.

Pumping Machinery.—Dy. cap., 5,000 galls.; from Aermotor Co., Chicago, Ill. No boilers.

Reservoir.—Cap., 60,000 galls.; 25 ft. sq., 15 ft. deep.

Distribution.—*Mains*, 3-in. w. i., 5/8 miles; from Morris, Tasker & Co., Philadelphia, Pa. *Hydrants*, 1.

Consumption, 1,000 galls. *Pressure*, 75 lbs.

Financial.—Cost, $1,500. Cap. stock, $3,000. Debt, $185. Int., 8%. Hydrant rental, $25.

Management.—Prest., J. W. Tucker. Secy., W. M. Graham, Treas., W. T. Clark. Report, Jan. 7, '90.

TALLADEGA, *Talladega Co.* (Pop., 1,233; est., 5,000.) Is 36 miles from Jacksonville.

History.—Built in '86 by Talladega Gas Light & Water Co., under a 25 years franchise. Engr., Geo. P. Anderton, Secy.

Water Supply.—Spring, pumping to sand-pipe.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; two 750,000 pumps made at Birmingham (Ala.) Iron Works.

Stand-Pipe.—Cap., 138,000; 14 x 120 ft.

Distribution.—(In '87.) *Mains*, c. i., 4 miles, *Services*, lead. *Taps*, 163. *Meters*, none. *Hydrants*, not given.

Consumption (in '87), 40,000 galls. *Pressure:* Ordinary, 80 lbs. Fire, 90 lbs.

Financial.—(In '87.) Cost, $40,000. Cap. stock, $60,000. Bonded debt, $40,000. Int., not given. Ann. op. exp., withheld, est., $1,500. Ann. rev.: consumers, withheld est., $3,000; city, $2,580. Hydrant rental, $60.

Management.—(In '88.) Prest., Jos. A. Shakespeare. Secy., Geo. P. Anderton. Supt and Pumping Engr., Jas. M Scott.

NOTE.—No reply to inquiries sent in '89.

TROY, *Pike Co.* (Pop., 2,294; est., 3,000.) Has considerable cotton trade. Incorp. No sewers or electric lights.

TEMPORARY WORKS.

In '86 town laid two miles of iron pipe from spring, put in small pump and built tank 6 x 10 ft. x 4 ft. deep. This was done at cost of $1,200, and as an experiment, only, intention being to make contract with some Co. for complete system.

PROPOSED PERMANENT WORKS.

General Description.—Later part of '89 city granted 20-years franchise to E. Woltmann, 11 Wall St., N. Y. City. Supply to be pumped from wells to stand-pipe 15 x 90 ft. Franchise provides for about 5 miles of mains and 60 hydrants at $50 each. Address above.

NOTE.—New works reported in '88 MANUAL were not built.

TUSCALOOSA. *Tuscaloosa Co.* (Pop., 2,451; est., 5,000.) On Black Warrior river at head of steamboat navigation, in cotton district. Incorp. No sewers. Has electric lights.

History.—Built in '88 by Tuscaloosa Water-Works Co., under 30-years franchise. Engr., A. E. Boardman, of Jeter & Boardman Gas & Water Assn., Macon, Ga., Contrs.

Water Supply.—Warrior river, pumping to tank.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; Worthington.

Tank.—Cap., 135,000 galls.; on tower.

Distribution.—*Mains* c. i., 7 miles. *Services*, galv. i. Pipe and specials from R. D. Wood & Co., Philadelphia, Pa. *Taps*, 180. *Meters*, none. *Hydrants*, Mathews, 50. *Valves*, Eddy.

Consumption, 148,000 galls. *Pressure:* Ordinary 50 lbs. Fire, 100 lbs.

Financial.—Cost, $66,000. Cap. stock, $75,000. Bonded debt, $50,000. Int., 6%. Sinking fund, $2,000 per annum. Ann. op. exp. and rev., not determined time of report. Hydrant rental, $50.

Management.—Prest., J. W. Wilcox. Secy., W. C. Fitts. Treas., A. E. Boardman, Macon, Ga. Supt., W. V. Todd.

Water-Works Projected with Fair Prospects of Construction.

BRIDGEPORT, *Jackson Co.* (Pop., est., 300.)

Proposed Works.—Address Bridgeport Land & Improvement Co.

GREENVILLE, *Butler Co.* (Pop., 2,471; est., 3,000.) Has lumber and cotton mills and wagon manufactories.

Proposed Works.—To be built by city. Address J. R. Porterfield.

NOTTINGHAM, *Talladega Co.* (Pop., not given.)

Proposed Works.—Address Nottingham Iron & Land Co. Unofficially reported fall of '89, Nottingham Electric Light & Water Co. was to build.

UNIONTOWN, *Perry Co.* (Pop., 810; est., 2,000.) In cotton and canebrake region. Incorp. city. No sewers or electric lights.

Proposed Works.—Mar. 1, '90, city had sunk artesian well, 1,100 ft.; 10-in. for 1,044 ft., then 8 ins. in diam.; contrs., D. Dull, N. Y. City. Owing to "kink" in pipe boring was stopped, and it was decided to cut the pipe at 950 ft., and pump to stand-pipe from about 150 ft. below surface. Mains will (probably) be laid on 4 principal streets. City Clerk, J. A. Hudson.

Water-Works Projects Reported in '89 and '90, but Now Indefinite.

Cullman, Cullman Co.; see MANUAL for '88, pp. 281-2. *Marion*, Perry Co.; see MANUAL for '88, p. 282. *Tuscumbia*, Colbert Co.

MISSISSIPPI.

Water-Works Completed or in Process of Construction.

BILOXI, *Harrison Co.* (Pop., 1,540; est., 4,000.) Manufacturing and shipping town, 8 miles from New Orleans, La. Incorp. town.

History.—Built in '89 by Biloxi Artesian Water-Works Co., under 25-years franchise; put in operation in Nov. Const. Engr., Frank Sutter.

Water Supply.—Artesian wells, by gravity. Wells 860 ft. deep, at 80 ft. elevation.

Distribution.—*Mains*, 4½ to 2-in. w. i.; from L. M. Rumsey Mfg. Co., St. Louis, Mo.; laid by Frank Sutter. *Taps*, 100. *Meters*, Worthington, 1. *Hydrants*, Alaska, 32. *Valves*, Ludlow. *Pressure*, 20 lbs.

Financial.—Cost, $8,000. Cap. stock, authorized and paid up, $8,000. Hydrant rental, free.

Management.—Prest., Jno. Walker. Secy. and Treas., Chas. E. Theobald.

COLUMBUS, *Lowndes Co.* (Pop., 3,995; est., 5,760.) On Tombigbee river, which is navigable for steamboats to this point. Settled in '19. Incorp. Has sewers. No electric lights.

History.—Built in '67 by city.

Water Supply.—Two artesian wells, pumping to reservoirs. First well is 4 ins. in diam.; dy. cap., 150,000 galls. Second one was bored in '88.

Pumping Machinery.—Dy. cap., 500,000 galls.; two No. 7 Knowles.

Reservoir.—Cap., about 40,000 galls.; brick in cem., 12 ft. in diam. at base, 18 at top, 30 ft. deep. Contr., Ben Taylor. Cost, $7,000.

Distribution.—*Mains*, c. i., 6½ miles. *Services*, w. i. *Taps*, 250. *Meters*, none. *Hydrants*, kind not given, 30. *Close of '76*: Mains, 1 mile. Taps, 52. Meters, none. Hydrants, 5. *Do.*, '80: Mains, 3 miles. Taps, 110. Meters, 3. Hydrants, 20.

Consumption, 300,000 galls. *Pressure*, 20 lbs.

Financial.—Cost, $50,000. No debt. Ann. op. exp., $2,000. Ann. rev.: consumers, $2,150; city, none. Cost in '76, $20,000; do., '80, $25,000. Rev., '76, $600; do., '80, about $1,000.

Management.—City Council. Supt., A. S. Frierson.

GREENVILLE, *Washington Co.* (Pop., 2,191; est., 2,500.) On Mississippi river, in cotton district.

NOTE.—In '87 city contracted with Greenville Water-Works Co., under 30-years franchise. (See MANUAL for '88.) Co. having failed their contract, council, in '89, made contract with Delta Water-Works, Sewerage and Light Co., for 30 years. Delta Co. is organized with cap. of $100,000. All stock subscribed for by citizens of Greenville. Conditional contract provides for 100 hydrants at rental of $60, additional at $50, also exemption from taxation for 10 years. Unofficially reported that J. A. Jones is Contr. for Co., and that a 2,500,000 Gordon pump will be used.

JACKSON, *Hinds Co* (Pop., 5,204; est., 6,000.) On Pearl river.

History.—Built in '88-9 by Jackson Light, Heat & Water Co. Engrs. and Contrs., Moffett, Hodgkins & Clarke, Watertown, N. Y. Engr. for Co., Eugene Carroll.

Water Supply.—Source not given, pumping to stand-pipe.

Pump-Well.—Pump set in well 24 ft. in diam. and depth; walls of brick in cem. mortar.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two Deane, comp., and high-pressure. *Boilers:* two 60-H. P.; from Sharon (Pa.) Boiler Works.

Stand-Pipe.—Cap., 230,000 galls.; 24x68 ft.; ½ to 3-16-in. steel: on brick foundation, anchored by six 2-in. bolts. On hill 120 ft. above lowest part of town. Contrs., Riter & Conley, Pittsburgh, Pa.

Distribution.—*Mains*, 12 to 4-in. c. i., 13 miles. *Hydrants*, kind not given, 101; 21 for State buildings.

Consumption, not determined. *Pressure*, about 40 lbs.

Financial.—Cost about $100,000.

Management.—Prest., A. L. Saunders, Supt., Chas. Dudley.

NOTE.—Other date not determined. Above subject to revision, as works were just completed at time of report.

MERIDIAN, *Lauderdale Co.* (Pop., 4,008; est., 12,000.) Has railroad repair shops and some manufactories.

History.—Built in '86-7 by Meridian Water-Works Co.; controlled by American Water-Works & Guarantee Co., Ltd., Pittsburgh, Pa. Engr., S. M. Highlands, Pittsburgh, Pa. Franchise, 25-years

Water Supply.—Springs and surface water, pumping from collecting and storage reservoir.

Reservoir.—Cap., 200,000,000 galls.

Pumping Machinery.—Dy. cap., 5,500,000 galls.; 2,500,000 Worthington comp.; 3,000,000 Gordon comp., cond.

Distribution.—*Mains*, c. i., 12 miles. *Services*, galv. i. Pipe and specials from R. D. Wood & Co., Philadelphia, Pa. *Taps*, 400. *Meters*, 8. *Hydrants*, Ludlow, 90. *Valves*, Ludlow.

Consumption, 400,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 90 lbs.

Financial.—(For '87.) Cost, $125,000. Cap. stock, $150,000. Bonded debt, $110,000. Int., not given. Ann. op. exp., $2,400. Ann. rev.: consumers, $5,000; city, $4,500. Hydrant rental, $50.

Management.—Prest., W. W. George. Secy. and Treas., S. M. Highlands, Pittsburgh, Pa. Supt., Geo. B. Opp.

NATCHEZ, *Adams Co.* (Pop., 7,058; est., 12,000.) On Mississippi river. Has cotton mills, foundries and other manufactories. Incorp. city. Has sewers and electric lights.

History.—Built in '89 by Natchez Water & Sewer Co., under 30-years franchise; put in operation in Aug. Co. has about 7½ miles of sewers which it operates in connection with water-works, receiving $6,000 per year from city. Des. Engr., J. Jones. Const. Engr., P. K. Yates, Natchez.

Water Supply.—Mississippi river, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; from N. O. Nelson Mfg. Co., St. Louis; two 1,500,000, a comp. and a high-pressure. *Boilers:* from Mid-Continenta Boiler Works, Kansas City, Mo.

Stand-Pipe.—Cap., 127,000 galls.; 12 x 150 ft.; from Frank E. Palmer, Kansas City, Mo.

Distribution.—*Mains*, 14 to 6-in., c. i., 8 miles. *Services*, galv. i., lead. Pipe and specials from So. St. Louis (Mo.) Foundry; trenching and pipe-laying done by Henry Diedrich, Natchez. *Hydrants*, White, 115. *Valves*, Eddy.

Pressure: Ordinary, 70 lbs. Fire, 100 lbs.

Financial.—Cost (including sewers), $160,000. Cap. stock, $250,000. Hydrant rental, $50.

PASS CHRISTIAN, *Harrison Co.* (Pop., 1,410; est., winter, 1,600; summer, 2,500. Watering place.

General Description.—Pass Christian Artesian Well Assn., East End Co. and West End Co. Each have an artesian well and supply water from same. Wells from 2 to 4 ins. in diam., 450 to 500 ft. deep, and throw water from 25 to 35 ft. vertically. The 2-in. wells discharge from 50 to 75 galls. per minute. Each well supplies from 3,000 to 4,000 ft. of mains, having ¾-in. service connection. One main supplies 92 faucets. J. H. Lang, Prest. N. Butchert, Secy. and Treas. of first and last-named Cos. Date report, Mar. 6, '90.

VICKSBURG, *Warren Co.* (Pop., 11,814; est., 15,000.) On Mississippi river. Engaged in river trade; has manufactories. Incorp. No sewers. Has electric lights.

History.—Built in '87-8 by Vicksburg Water Supply Co. Chf. Engr., C. Delafield. Asst., Chester R. McFarland. Contr., Saml. R. Bullock. Both of N. Y. City.

Water Supply.—Mississippi river, pumping from settling basin direct or to stand-pipe.

Pumping Machinery.—Dy. cap., 4,000,000 galls.; four Deane comp., cond.; additional 1,000,000 pump, unofficially reported as contracted for in '89.

Stand-Pipe.—Cap., 412,000 galls.; 22 x 145 ft.; from Tippett & Wood, Phillipsburgh, N. J.

Distribution.—*Mains*, c. i., 14 miles. *Services*, w. i., lead. Pipe and specials from Dennis Long & Co., Louisville, Ky. *Taps*, withheld, est., 500. *Meters*, not given. *Hydrants*, kind not given, 100.

Financial.—Cost, withheld, est., $175,000. Cap. stock, $250,000. Bonded debt [authorized ?]. $250,000. Int., 6%. Ann. op. exp. and rev., not determined at time of report. Hydrant rental, $65.

Management.—Prest., Wm. Yorke At Lee, 2 Wall street, N. Y. City. Secy. and Treas., W. G. Snow.

Water-Works Projected With Fair Prospects of Construction.

CORINTH, *Alcorn Co.* (Pop., 2,275; est., 3,000.) Has iron works.

Proposed Works.—Effort being made to build works, but no cap. secured; Co. ownership. Supply, wells, pumping to tank. Report by B. D. Sory; date. Feb. 28, '90.

DURANT, *Holmes Co.* (Pop., 723; est., 2,000.) Has manufactories.

Proposed Works.—Illinois Central R. R. Co. has wells, pump and tank for railway purposes, and has offered use of same in case of fire, provided city will lay mains and place hydrants. Est. cost to city, $1,000. Date report, Jan. 7, '90.

GREENVILLE, *Washington Co.* (Pop., 2,191; est., 2,500.) On Mississippi river.

Proposed Works.—Address J. S. Walker. Unofficially reported, latter part of '89, that 4 wells had been successfully sunk and that contract to build works had been let to J. A. Jones.

Water-Works Projects Reported in '89 and '90, but now indefinite.

Oxford, La Fayette Co. *Yazoo City*, Yazoo Co.

LOUISIANA.

Water-Works Completed or in Process of Construction.

BATON ROUGE, *East Baton Rouge Co.* (Pop., 7,197; est., 10,000.) On Mississippi river. Incorp. No sewers. Has electric lights.

History.—Built in '88 by Baton Rouge Water Co. Engr., E. Smedley, of National Iron & Brass Works, Dubuque, Ia., Contrs.

Water Supply.—Mississippi river, pumping to stand-pipe and direct.

Pumping Machinery.—Dy. cap., 3,750,000 galls.; 3 Smedley; two 1,500,000 comp., dup., cond., one 750,000 high-pressure.

Stand-Pipe.—Steel, 100 ft. high.

Distribution.—*Mains*, 6½ miles. *Taps* 100. *Meters*, 2. *Hydrants*, kind not given, 83.

Consumption, 125,000 galls. *Pressure*, not given.

Financial.—Cost, withheld, est., $75,000. Cap. stock, $100,000. Debt, $60,000. Int., 6%. Ann. op. exp., withheld, est., $2,000. Ann. rev.: consumers, $2,500; city, $4,500. Hydrant rental, $60.

Management.—Prest., Wm. Garig. Secy., Jno. H. Wood. Treas., C. H. Meyer. Supt., L. P. Amiss.

NEW ORLEANS, *Orleans Co.* (Pop., 216,090; est., 230,000.) On left bank of Mississippi river, 115 miles from mouth, and on south side of Lake Pontchartrain.

City limits have frontage of 13 miles on curve in river, and of 7 miles on lake, 5 miles distant. This area lies below high water level of both river and lake, and is enclosed by levees, and drained by canals, water being pumped over levees. Main part of city lies along river for about 6 miles, with av. width of 1¼ miles. In '89 there were 36,500 dwellings within this area. Largely engaged in foreign and domestic commerce, especially in cotton trade; has manufactories. Founded in 1718 by the French. No sewers. Has electric lights.

History.—Built in '33 by private company, and now owned by New Orleans Water Co.

In '33, when works were built, population was 70,000, and until then water had been taken from wells and cisterns. Des. Engr. for original works was Erastus W. Smith, who, with Albert Stein, of Mobile, Ala., was also Const. Engr. Albert Stein was Contr. for first reservoir.

In '68 city bought works for $1,300,000, and in '78 sold them to New Orleans Water Co, at same time authorizing issue of $600,000 of bonds for improvements. Moses Lane was Engr. for latter work.

Company's exclusive privilege to supply city with water has been confirmed by U. S. Supreme Court, their rights extending to 1928.

Water Supply.—Mississippi river, pumping to reservoirs, stand-pipe and direct. One reservoir serves as settling basin. As late as '81, large portion of the pop. took domestic supply from cisterns, filled with rain water.

Pumping Machinery.—Dy. cap., 34,000,000 galls.; from Allaire Works, Variety Works, and 5,000,000 Knowles added in connection with the stand-pipe in '78.

Reservoir.—Cap., 4,000,000 galls.; 1,000 ft. from pumps; for night and Sunday service, giving 30 ft. head all over city.

Stand-Pipe.—1s 7 x 174 ft.: from McRitchie & Nichol, Chicago.

Distribution.—*Mains*, c. i., 75 miles. *Services*, lead. Pipe and specials lately furnished by R. D. Wood & Co., Philadelphia, Pa., Dennis Long & Co., Louisville, Ky., and Chattanooga (Tenn.) Foundry and Pipe Works; trenching and pipe-laying done by Co. *Taps*, 4,178. *Meters*, 18. *Hydrants*, 1,195; 6 different makes, Holly latest. *Valves*, Chapman now used exclusively. *Pressure-recording gauge*, Edson.

Consumption, 7,000,000 galls. *Pressure*, 25 lbs.

Financial.—Cost, $2,395,000 galls. Cap. stock, authorized, $2,000,000; issued, not given. Bonded debt, $395,000. Int., 6%. Ann. op. exp., $85,363. Ann. rev.: consumers, $105,489; city, $68,400. Hydrant rental, $60 each for 1,160.

Management.—Prest., R. E. Craig. Secy. and Treas., R. S. Macmurdo. Supt. L. H. Gardner.

References.—"Seven Years of Litigation between the City of New Orleans and the Water Co.," *Eng. News*, vol. XXII., p. 233.

Tenth Census, U. S., vol. XVII., Water Supply of American Cities, pp. 153-4.

SHREVEPORT, *Caddo Co.* (Pop., 8,009; est., 16,000.) On Red river, in cotton region; engaged in river and other trade. Incorp. Has sewers and electric lights.

History.—Built in '86-7 by Shreveport Water-Works Co., under a 30-years franchise. Sold in '87 to First Natl. Bank of New York City. Engr., E. F. Fuller. Contr., Saml. R. Bullock. Both of N. Y. City.

Water Supply.—Cross bayou, pumping to settling basins and stand-pipe, filtered.

Pumping Machinery.—Dy. cap., 2,000,000 galls.: four Blake; two single, two comp. *Boilers:* Abendroth & Root.

Settling Basins.—Two, of 1,250,000 galls. each.

Filters.—Dy. cap., 1,0 0,000 galls.; Hyatt; erected Dec., '89.

Stand-Pipe.—Cap., 258,000 galls.; 20 x 110 ft.; from Tippett & Wood, Phillipsburgh, N. J.

Distribution.—*Mains*, c. i., 8½ miles. *Services*, w. i., lead. Pipe and specials from Dennis Long & Co., Louisville, Ky. *Taps*, 382. *Meters*, none. *Hydrants*, Ludlow, 120. *Valves*, Ludlow.

Consumption, 700,000 galls. *Pressure:* Ordinary, 86 lbs. Fire, 175 lbs.

Financial.—Cost, $250,000. Cap. stock, $250,000. Bonds, $250,000. Int., 6%. Ann. op. exp., withheld, est., $2,500. Ann. rev.: consumers, $10,000; city, $8,800. Hydrant rental, $50.

Management.—Prest., Wm. Yorke At Lee, 2 Wall St., N. Y. City. Secy. and Treas., W. G. Snow. Supt., Jno. B. Crawley.

Water-Works Projected with Fair Prospects of Construction.

ALEXANDRIA, *Rapides Co.* (Pop., 1,800; est., 3,000.)

Proposed Works.—Unofficially reported first part of '89 that artesian well had been sunk, and later, that works would be built. Nothing further had been done Sept. 9, '89. Mayor, Thos. Crawley.

AMITE CITY, *Tangipahoa Co.* (Pop., 1,120.) Has gin-factory.

Proposed Works.—Address L. L. Fugler or E. E. Cooley.

Water-Works Projects Reported in '89 and 90, but Now Indefinite.

Lake Charles, Calcasieu Co.

TENNESSEE.

Water-Works Completed or in Process of Construction.

ATHENS, *McMinn Co.* (Pop., est., 2,500.) In agricultural region.

History.—Built in '88 by Athens Mining and Mfg. Co. Contrs., Union Iron Works, Chattanooga.

Water Supply.—Ingleside Spring, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 500,000 galls.; dup. *Boiler:* return tubular.

Stand-Pipe.—Cap., about 50,000 galls.; 12½ x 70 ft. Built by Contrs.

Distribution.—*Mains*, 4 miles.

Financial.—Cost, $25,000. No cap. stock or bonds.

Management.—Prest., F. F. McElwee. Secy. and Genl. Mgr., R. J. Fisher.

NOTE.—No further data.

BRISTOL, *Sullivan Co.* (Pop., 1,647; est., 5,000.) On Virginia State line. Has tobacco warehouse and factories, and cotton and woolen mills. Incorp. No sewers. Has electric lights.

History.—Built in '88-9 by Bristol-Goodson Water Co. to supply Bristol, and Goodson, Va. Engr. and Contr., W. W. Taylor, Philadelphia, Pa.

Water Supply.—King's spring, issuing from limestone, pumping to tank.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Blake steam and two Silsby water-power; former auxiliary.

Tank.—Cap., 100,000 galls.; white juniper, on circular brick tower. Contr., Geo. Woodford, Philadelphia, Pa.

Distribution.—*Mains*, 12 to 4-in. c. i., 6¼ miles. *Services*, galv. i., lead. Pipe and specials from South Pittsburgh Pipe Works. *Taps*, 125. *Meters*, 4. *Hydrants*, Taylor, 42. *Valves*, W. S. Payne & Co's.

Consumption, 200,000 galls. *Pressure:* Ordinary, 75 lbs. Fire, 100 lbs.

Financial.—Cost, $75,000. Cap. stock, $75,000. Bonded debt, $40,000. Int., 6%. Ann. op. exp. and rev., not determined. Hydrant rental, $40 for first 25, and $35 for additional.

Management.—Prest. and Gen. Mgr., Saml. L. King, Bristol. Secy., B. R. McDowell. Treas., F. B. Hubbell, Baltimore, Md.

BROWNSVILLE, *Haywood Co.* (Pop., est., 4,500.) Is five miles from Hatchet river in a cotton district.

NOTE.—Works reported in MANUAL of '88 as under construction were abandoned after some preliminary work.

CHATTANOOGA, *Hamilton Co.* (Pop., 12,892; est., 40,000.) On Tennessee river, on limestone hills rising 300 ft. above water. Has iron and various other manufactories. Settled in '40; incorp. in '50. Has sewers and electric lights.

History.—Built in '64 by U. S. Government, and purchased soon after by private company, which operated them a short time, failed, and sold them to Lookout Water Co. In '86 or '87 works came under control of American Water-Works & Guarantee Co., Ltd., Pittsburgh, Pa., local name being City Water Co. In '87-8 new pumping plant was put in two miles up river.

Water Supply.—Tennessee river, filtered, pumping to reservoir.

At one time city was wholly or partially supplied from tunnel driven into Lookout Mountain, 600 ft. above low ground.

Pumping Machinery.—Dy. cap., 20,000,000 galls.; two Knowles, and one 6,000,000 Deane, latter placed in '88. A 8,500,000 high duty Worthington added in '89.

First pump was Woodward of 18-in. steam and 9-in. water cylinder, and in '71 a dup. pump of same kind and size was added. In '77 another dup. pump of 20-in. steam and 12-in. water cylinders was placed, and in '81 a Worthington with 20 x 30-in. steam and 14-in. water cylinders. It is not stated whether any or all these old pumps have been abandoned.

Filters.—Dy. cap., 5,000,000 galls.; National.

Dam and Reservoirs.—Cap., 8,000,000 galls. *Old:* cap., 3,000,000 galls.; in two compartments, 150 wide, 155 and 160 ft. long, respectively, 12 ft. deep, 175 ft. above river, 125 ft. above business part of city. Lined with puddle and paved with brick. Compartments can be filled and emptied alternately, which was very necessary before filters were placed, that water might settle.

Ridgedale: cap., 5,000,000 galls.; area, 1¼ acres; for reserve supply. Dam of puddled earth on clay and gravel, mixed, foundation; 490 ft. long, 22 ft. high, 19 ft. of water; 10 ft. wide on top, 60½ at bottom. Inner slope, 1½ to 1, paved with brick laid flat, bedded in cem. on 18 ins. mud puddle; outer, 1¼ to 1, sodded. *Spillway:* 10 ft. from south end of dam, free; 12-in. c. i. pipe, 36 ft. long, drawing water 3 ft. below top of dam; slope, 1 in 12. *Discharge-pipe:* 24-in.; slope, 1 in 20 Dam does not leak; Built in '89. Des. Eng., Nisbet Winfield, Supt. Const. Engr., Jas. A. Morrow, Hornellsville, N. Y. Contrs., Duncan Bros., Chattanooga. Cost, $9,000.

Latter part of '89 water was discharged from reservoir through leak in bottom at point where excavation was 20 ft. deep. Water went into subteranean channel.

Distribution.—*Mains*, c. i., 5¼ miles. *Services*, galv. i., lead. *Taps*, 3,550. *Meters*, 25. *Hydrants*, Ludlow, Mathews, 200. *Valves*, Ludlow, Eddy. *Pressure-recording gauge*, Edson.

Consumption, 5,250,000 galls. *Pressure*, 55 lbs.

Financial.—(In '87.) Cost, $600,000. Cap. stock, $500,000. Bonded debt, $469,000. Int., 6%. Ann. op. exp., withheld, est., $10,000. Ann. rev.: consumers, withheld, est., $57,000; city, $5,000 during first five years of contract, $7,000 for next, and $9,000 for last.

Management.—Prest., J. S. Kuhn. Secy., S. M. Highlands. Both of Pittsburgh, Pa. Treas. and Supt., N. Wingfield.

CHATTANOOGA WATER & POWER CO.

History.—Built in '89, put in operation Sept. 20. Engrs., Guild & White. Supplies part of city above height which can be reached by works of City Water Co. Co. also operates horse surface and incline railways, connecting with park, hotel and observatory [presumably] on Lookout Mt.

Water Supply.—City Water Co.'s mains, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 720,000 galls.; McGowan. *Boilers:* Armstrong.

Stand-Pipe.—Cap., 60,000 galls., from Armstrong.

Distribution.—*Mains*, 8 to 2-in., material not given, 1½ miles; from Giles Pipe Co., Chattanooga. *Hydrants*, 4.

Consumption, 350,000 galls. *Pressure*, 150 lbs.

Financial.—Cost, $10,000. Cap. stock, $15,000. Bonds, $8,000. Ann. op. exp., est., $600. Hydrant rental, $25.

Management.—Prest., Jno. R. Dean. Secy., F. A. Berkstresser. Treas. and Supt., R. C. Cook.

NOTE.—One of above Cos. erected plant for supplying Lookout Mt., consisting of pumping machinery, 6-in. force main, 3,900 ft., long, rising 1,500 ft. and in one place rising perpendicularly for 250 ft. up side of cliff.

CLARKSVILLE, *Montgomery Co.* (Pop., 3,880; est., 7,500.) On Cumberland river, on high buff of white limestone and red clay, which is intersected by deep ravines. Largely engaged in raising, manufacturing and shipping tobacco. Settled in 1785. Incorp. No sewers. Has electric lights.

History.—Built in '79 by Travers Daniels, deceased; purchased by Clarksville Water Co. in Aug., '83. Mr. Daniels was Des. and Const. Engr.

Water Supply.—Cumberland river, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; two Blake, 500,000 Deane. The latter added in '84. First Blake, 14-in. bore.

Stand-Pipe.—Cap., 135,000 galls; 15 x 102 ft.; on highest ground in city, 275 ft. above pumps.

Distribution.—*Mains*, 8 to 4 in. c. i., 8½ miles. *Services*, w. i., lead. *Taps*, 348. *Meters*, Union, 5. *Hydrants*, Chapman, 45. *Valves*, Chapman.

Consumption, 300,000 galls. *Pressure*, 55 lbs.

Financial.—Cost (in '82), $45,000. Bonded debt (in '82), $50,000. Int., 6%. Ann. op. exp., withheld, est., $2,000. Ann. rev.: consumers, withheld, est., $4,000; city, $2,250. Hydrant rental, $50.

Management.—Prest., F. P. Gracey. Secy. and Treas., B. W. Macrae. Supt., R. E. McCulloch.

COLUMBIA, *Murray Co.* (Pop., 3,400; est., 5,000.) On Duck river, in mountainous district, 46 miles from Nashville. Has cotton and furniture factories and flouring mills. Settled in '19; chartered in '48, again in '69. Incorp. Partially sewered. Has electric lights.

OLD CITY WORKS.

General Description.—Built in '40, pumping from springs 150 ft. to brick and stone reservoir 20 x 30 ft., 11 ft deep, 80 ft. above city. Cope & Maxwell pump, erected in '77, and Deane pump, erected in '79. There were in '82 6 miles of 3-in. c. i. pipe, 120 taps, 1 meter, 2 hydrants and 6 gates. Cost in '82, unknown. Ann. op. exp., in '82, $3,000; receipts, $1,500

COLUMBIA WATER CO.'S WORKS.

History.—Above works bought in '84, and extended and improved. C. H. Ledlie, St. Louis, Mo., Const. Engr.

Water Supply.—Duck river, pumping to reservoir.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; Blake and Deane, 1,000,000 each; latter bought in '84.

Reservoir.—Cap., 700,000 galls. Old reservoir, described above, was enlarged to this cap.

Distribution.—*Mains*, c. i., Kal. i., 7½ miles. *Services*. w. i. *Taps*, 242. *Meters*, 11. *Hydrants*, Ludlow, Chapman, 56. *Valves*. kind, do.

Consumption, 125,000 galls. *Pressure*, 90 lbs.

Financial.—Cost, withheld, est., $104,000. Cap. stock, $50,000. Bonded debt, $60,000. Int., 6%. Sinking fund, $3,600. Ann. op. exp., $4,200. Ann. rev.: consumers, $5,200; city, $3,600. Hydrant rental, $70 for first 40, and $50 for all additional.

Management.—Prest., Jas. Gamble, N. Y. City. Treas., L. Frearson. Supt., I. J. Odell.

NOTE.—Unofficially reported in '89 that works had been bought by Columbia Improvement Co.

DYERSBURG, *Dyer Co.* (Pop., 1,010; est., 1,500.) On Forked Deer river. Has carriage factory, foundry, steam, flouring and saw mills.

History.—Built in '88 by Frank Shephard. No other data; all requests ignored.

JACKSON, *Madison Co.* (Pop., 5,377; est , 15,000.) Has large machine and repair shops, ice and other manufactories. Incorp. Has sewers and electric lights.

History.—Built in '85 by city.

Water Supply.—Twenty-two bored wells, by direct pumping.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two 1,000,000 Knowles comp., dup.

Distribution.—*Mains*, c. i., 12 miles. *Services*, galv. i. *Taps*, 649. *Meters*, Crown, 4. *Hydrants*, Ludlow, Mathews, 141.

Consumption. 500,000 galls. *Pressure*, not given.

Financial.—Cost, $100.000. Debt, $100,000. Int., 6%. Ann. op. exp., $4,700. Ann. rev.: consumers, $8,650; city, none.

Management.—Three Trustees. Prest., W. F. Alexander. Secy. and Treas., A. D. Muse.

KNOXVILLE, WEST KNOXVILLE and NORTH KNOXVILLE, *Knox Co.* (Pop., 9,693; est., 40,000.) On the Tennessee river, at the head of steamboat navigation. Have large marble industries, saw mills, iron and nail works, cotton and woolen mills and railroad and car shops. W. and N. Knoxville incorp. cities in '89; formerly included under Knoxville, incorp. No sewers. Have electric lights.

History.—Built in '83 by Knoxville Water Co. Des. Engr., Moses Lane. Const. Engrs., Lockett & Fuller, and for remodeling in '84, A. H. Martine, Supt. Labor done by Co. City has the privilege of buying works at end of 30 years.

Water Supply.—Tennessee river, pumping to reservoir. Direct pumping can be used.

Pumping Machinery.—Dy. cap., 3,500,000 galls.; two Davidson comp., cond. *Boilers:* two horizontal; also two 4½ x 16 ft. horizontal, tubular steel, added in '89.

Force Main.—Of 14-in. c. i., 2,300 ft. long, with two right angle bends. Enters settling basin of reservoir, and also connects with effluent pipe, so direct pumping can be used.

Reservoir.—Cap., 3,000,000 galls.; area, about ½ acre; in earth, with division wall, forming two equal compartments. Division wall is 10 ft. wide on top, with slopes of 1 to 1. Main inner slopes, 1½ to 1, covered with 15 ins. of puddle, 4 ins. of stone and cem , then paved with brick, coated with ½-in. Portland cem. and sand. Outer slopes, 1¾ to 1, sodded. Upon a hill 234 ft. above low water in river, and from 100 to 110 ft. above the thickly built part of the city. Excavation was through tough red clay with slight admixture of sand and considerable quantities of small stone. Excavated material used in banks, and selected portions to puddle sides and bottom. Bottom puddled and covered with road metal. By boring it was found that at no part of bottom was there less than 20 ft. of clay above rock. *Discharge-pipes:* 16 and 14-in. Engrs., see History. Contr., F. M. Lowerce.

Water first pumped to reservoir May 28, '83, and until June 2 no leaks were discovered, but on evening of that day there was a break in bottom of north compartment, about 20 ft. sq., which let out all water and carried about 300 cu. yds. of earth, puddle and rock into cavities of limestone rock below. Three days later south compartment broke in a similar way, hole being larger. Water was temporarily supplied by direct pumping, but some passing to south compartment it was found that earth had filled cavity, allowing repairs to be made in other division, that to be filled then second one repaired.

Reservoir broke six times more, to June 1, '84, and water was finally kept at a depth of but 8 ft.

After first of breaks reservoir was lined with brick laid in mortar made of partly set cem. and river sand, with mud and sticks in it. This did not prove effectual, and work was reconstructed in '85 by Supt. A. H. Martine, he using for his mortar Portland cem. and clean sharp sand. Since these repairs reservoir has held water to full cap., but in '89 banks showed some signs of settling. Water frequently drawn off and banks examined. A very full account of first breaks and repairs is given by one of Const. Engrs, E. F Fuller, in *Eng. News*, Vol. XI, pp 92-3.

Distribution.—*Mains*, c. i., 21 miles. *Services*, galv. i. Pipe and specials from Chattanooga (Tenn.) Foundry and Pipe Works. *Taps*, 1,288. *Meters*, Crown. 18. *Hydrants*, Ludlow, Coffin, about 122. *Valves*, Ludlow, Coffin, Chapman.

Consumption. 1,500,000 galls. *Pressure*, 47 lbs.

Financial.—Cost, withheld, est., $375,000. Cap. stock, $200,000. Bonded debt, $235,000. Int., 6% Ann. op. exp., $11,168. Ann. rev.: consumers, $19,603; city, $5,990. Hydrant rental, $50 for $100, $45 for additional.

Management.—Prest., R. N. Hood Secy., Jno. M. Brooks. Treas. C. M. McClung. Supt., A. H. Martine.

MANCHESTER, *Coffee Co.* (Pop., 438; est., 700.) Has flour, wood pulp and paper mills. Not incorp. No sewers or electric lights.

History.—Built in '89 by J. E. Thompson, without Engr. or Contr.; put in operation about Sept. 15.

Water Supply.—Large spring, pumping direct.

Pumping Machinery.—Dy. cap., not given; Gould water-power.

Distribution.—*Mains*, 2-in. w. i., 4 miles.

Consumption, 10,000 galls. *Pressure:* Ordinary, 25 lbs. Fire, 60 lbs.

Financial.—Cost, $4,500. Ann. op. exp., est., $75. Ann. rev.: consumers, est., $1,200.

Management.—Owner, J. E. Thompson. Date report, Sept. 10, '89.

MEMPHIS, *Shelby Co.* (Pop., 33,592; est., 70,000.) On the Mississippi, just below mouth of Wolfe river, on fourth Chickasaw bluffs, about 35 ft. above highest floods. Ground falls from summit ridge to Mississippi on one side, and to Bayou Gayoso on other. Mississippi is navigable to this point for largest steamboats all the year. Laid out in '20; incorp. city in '27. Has sewers, Waring system, and electric lights.

History.—Built in '72 by Co., name not given; purchased and extended in '80 by Memphis Water-Works Co.; sold by them to Artesian Water Co. in '83, who at once began extending system, with Thos. J. Whitman, St. Louis, Chf. Engr., Thos. J. Johnson, formerly of Chicago, Resident Const. Engr.

For works built in '72 A. R. Ketcham was Consult., and Galen W. Pearsons, Kansas City, Mo., Const. Engr. For description of early works see MANUAL for '88, p. 288.

Water Supply.—Thirty-eight 8-in. artesian wells, pumping direct and to standpipe. Wells are 400 to 500 ft. deep, sunk through 20 ft. loam, 24 ft. sand and gravel, 150 ft. hard clay, 250 ft. into layer clean sand. A well sunk 1,165 ft. showed that the last layer of sand is 700 ft. deep, and that it yields water all its depth. Wells are within an area about 300 x 3,000 ft. They were connected temporarily at the surface, but as designed will connect by tunnel with pump-well.

This supply was introduced in '88, water having been previously taken from Wolfe river, as described under Memphis Water Co.'s works, MANUAL for '88, p. 288.

Tunnel and Pump Well.—Tunnel (as designed) is 2,000 ft. long, 5 ft. in diam. Pump-well (as designed) is 38 ft. in diam., 80 ft. deep, with brick and cem. wall sunk on shoe. Pumps will be in well. Contr., M. Philbin, Chicago.

Pumping Machinery.—Dy. cap., 13,000,000 galls.; 6,000,000, 3,000,000, two 2,000,000; latter Blake horizontal. New plant will comprise three 10,000,000-gall. Worthington pumps, contracted for in '88. These will be placed in dry well, and connected by tunnels with artesian wells.

Stand-Pipe.—Cap., 375,000 galls.; 20 x 160 ft.; 1¼ to ⅛-in. steel plates. Foundation, solid concrete and masonry, 38 ft. diam., 17 ft. deep.

Distribution.—*Mains*, c. i., 65 miles. *Services*, galv. i., lead. Pipe and specials furnished to present company by Dennis Long & Co., Louisville, Ky.; trenching and pipe-laying done by M. Philbin, Chicago, Ill. *Taps*, 4,750. *Meters*, 350. *Hydrants*, Ludlow, Chapman, Eddy, Holly, 300. *Valves*, kind, do.

Consumption, 8,000,000 galls. *Pressure*, 40 lbs.

Financial.—(In '87.) Cost, $850,000. Cap. stock, $750,000. Bonded debt, $100,000. Int., 6%. Ann. op. exp., withheld, est., $250 00. Ann. rev.: consumers. $100,009; city, $30,000 for all purposes, 20-years contract.

Management.—Prest., T. J. Latham. Secy., Lawrence Simpson. Treas., J. W. Macrea. Supt., W. Cameron.

Reference.—"The Water Supply of Memphis." By J. M. Safford. Tenn. State Board of Health Bulletin, Feb. 20, '90 Good detailed description of the wells and appurtenances.

MONTEAGLE, *Grundy Co.* (Pop., est., 500.) Summer resort.

History.—Built in '88 by Nashville, Chattanooga & St. Louis Ry. Co. to supply their watering station and the summer visitors.

Water Supply.—Spring, pumping to tank.

Pumping Machinery.—Dy. cap., 300,000 galls.; Worthington.

Force Main.—Diam., 4 ins.; length, 7,400 ft.; rise, 975.

Tank.—Cap., 30,000 galls.

Distribution.—*Mains*, 3-in.

Financial.—Cost, est., $15,000. No rev.

Management.—Nashville, Chattanooga & St. Louis Ry. Co., offices, Nashville. Report by Asst. Engr., B. L. Blackie, Nashville.

MURFREESBORO, *Rutherford Co.* (Pop., 3,800; est., 4,000.) Is 32 miles from Nashville. Incorp. town. Imperfect sewers. No electric lights.

History.—Built in '88 by town for fire protection; operated by Gas Light Co. Duplicate pumps may be added in '90 and domestic supply furnished. Engr., H. B. Collins, Murfreesboro. Contrs., C. and H. B. Collins, Murfreesboro. **Water Supply.**—Creek, fed by springs, direct pumping. **Pumping Machinery.**—Dy. cap., 100,000 galls.; McGowen. *Boilers:* from J. H McGowen & Co., Cincinnati, O. **Distribution.**—*Mains*, 6 and 4-in. c. i., 1½ miles; from Chattanooga Foundry & Pipe Works. *Hydrants*, Ludlow, 15. *Pressure*, 30 to 120 lbs. **Financial.**—Cost, $7,000. Bonded debt, $7,000, 20-year. Int., 6%. Ann. op. exp., $650.; paid by city to Gas Ligh, Co. **Management.**—Gas Light Co. Supt., H. B. Collins.

NASHVILLE, *Davidson Co.* (Pop., 43,350; est., 80,000.) On south bank of Cumberland river, on rocky bluffs rising from 80 to 175 ft. above low water. Has cotton-seed oil mills, iron foundries, stove works, machine shops, rolling and cotton mills, iron furnaces, charcoal works, and other manufactories. Settled in 1799; Incorp. town in '06. Has sewers and electric lights.

History.—Built in '32 by town when pop. was about 6,000. Des. Engr., Albert Stein. New pumping plant, filter and reservoir added in '88.

Water Supply.—Cumberland river, pumping to stand-pipe and reservoir.

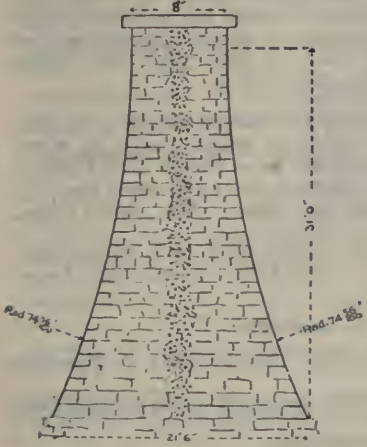
Filter Gallery.—Dy. cap., est., 10,000,000 galls; 2,000 ft. long, 4 ft. wide, 7 to 10 ft. deep. Finished in '88. Cost, $16,000. At low water in '89 filter failed to yield above amount, and considerable water was taken directly from river.

Pumping Machinery.—Dy. cap., 10,000,000 galls. *Old Station:* four 2,500,000 Worthington comp., cond., and also a horizontal engine with vertical pumps having a cap. of 4,000,000 galls., placed in '55, and now kept as a reserve. Cylinder of latter pump, 24 x 120 ins. First pump was direct-acting, 26 x 96 ins. In '78 two dup. Deane pumps were placed, but these are not used. *Boilers:* two batteries of 5 each, those in first, 18 x 4½ ft., in new, 20 x 6 ft. *Stacks:* first, 100, second, 139 ft. above grate.

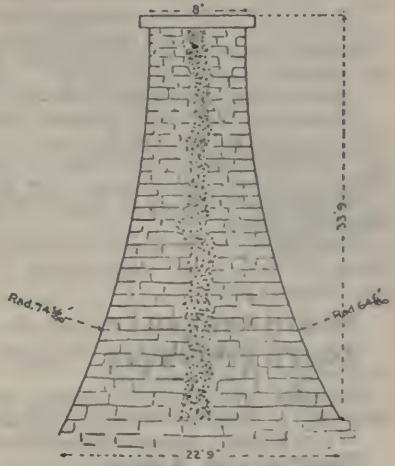
New Station: cap., 10,000,000 galls.; Gaskill, vertical, high duty, working against 300 ft. head; guaranteed duty, 72,005 galls., based on evaporation of 8 lbs. of water. Built in '88. Second 10,000,000 pump has been contracted for, to be finished in '90. Buildings cost $100,000, pump the same. *Boilers:* 6 tubular, 18 x 5½ ft.; from Union Iron Works, Chattanooga,

Old Reservoir.—Cap., 2,500,000 galls. In '84 test was made by Olin H. Landreth of leakage of reservoir, which was found to be 1,300,000 galls. a day. Further investigations and repairs were advised, but it is not stated whether these were made. Reservoir 177 ft. above low water, while some points are 176, 165 and 160 ft. above same level.

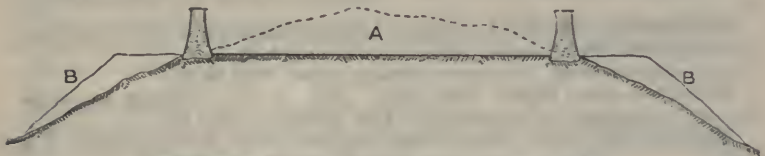
New Reservoir.—Cap., 51,800,000 galls.; area, 5 acres; 31 ft. of water; 1½ miles from capitol; bottom 277 ft. above low-water in river, 100 to 200 ft. above city. On hill composed of limestone in horizonal layers, covered in places with earth and clay. Top of hill leveled to form bottom, rock used for walls, clay and earth placed



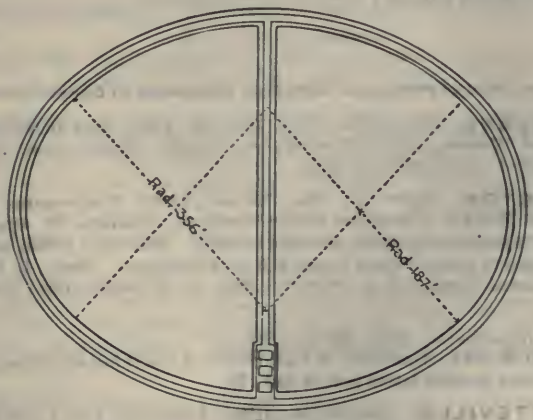
Section of Division Wall.



Section of Main Wall.



Cross-Section, showing method of excavating and filling.



Plan.

New Reservoir, Nashville, Tenn.

outside walls to form driveway. For details and dimensions see cuts. Bottom covered with concrete. *Heart-wall:* rich concrete, 18 ins. thick. *Discharge-pipe:* 36-in. Built in '89 for settlement, storage and distribution. Chf. Engr., J. A. Jowett. Asst. Const., H. P. B. Rigby. Contrs., Whitsit & Adams. Cost, $385,000. See Reference, below.

Stand-Pipe.—For regulating pressure; 3 x 114 ft., encased in brick, having an inside circular wall fitting around pipe, and an outside wall 13 ins. thick, 12 ft. sq. at base, tapering to 5 ft. 2 ins. at top. Space between two walls for about 90 ft. from bottom, where they join. On bluff 160 ft. high. Has stood well.

Distribution.—*Mains*, 46 to 3-in. c. i., 44.7 miles. Nov. 11, '86, a 24-in. main burst, piece blown out having area of about 4 sq. ft. Break was in bottom of pipe, which rested on sand and clay. There was no flaw in pipe, and pressure was not over 65 lbs., unless caused by water ram. *Services*, c. i., lead. *Taps*, 4,496. *Meters*, 15. Hydrants, Ludlow, Mathews, 550. *Valves*, Eddy, Galvin.

Consumption, 8,970,566 galls. *Pressure*, 10 to 60 lbs.

Financial.—Cost, about $2,200,000. Bonded debt, $900,000: $600,000 at 4½, $300,000 at 4%. Ann. op. exp., $45,182. Ann rev.: consumers, $83,885. Cost to '81, $1,500,000. Cost of extensions, '85 to '88, inclusive, $617,588. Gross receipts to '81, $1,215,227. There was no bonded debt the first of '80, but $75,000 of bonds were issued that year.

Management.—Board of Public Works and Affairs. Chn., Robt. Ewing. Supt., Geo. Reyer.

Reference.—"New Reservoir at Nashville, Tenn." By H. De B. Parsons, *Eng. News*, Vol. XIX., p. 484. Tenth Census, U. S., Vol. XVII., Water Supply American Cities, pp. 78-9.

NORTH KNOXVILLE, *Knox Co.* See Knoxville.

SOUTH PITTSBURG, *Marion Co.* (Pop., 1,045; est, 3,500.) On Tennessee river, 27 miles from Chattanooga.

History.—Built by private company, date not given; now owned by South Pittsburg City Co. Engr., W. Manthey, deceased.

Water Supply.—Springs, by gravity and pumping.

Reservoir.—Cap., 34,000 galls.

Pumping Machinery.—Dy. cap, 1,000,000 galls.; kind, not given. Added in '89.

Distribution.—*Mains*, c. i., 4½ miles; from So. Pittsburg Pipe Works. *Services*, w. i. *Taps*, 300. *Meters*, none. *Hydrants*, no special kind, 16.

Consumption, 70,000. *Pressure:* Ordinary, 80 lbs. Fire, 180 lbs.

Financial.—Cost, $25,000. Debt, none. Ann. op. exp., withheld, est., $1,000. Ann. rev.: consumers (in '87), $5,000; city, $400. Hydrant rental, $50.

Management.—Prest., Jas. L. Gaines, Nashville. Secy., Treas., and Supt., F. P. Clute.

WEST KNOXVILLE, *Knox Co.* See Knoxville.

Water-Works Projected with Fair Prospects of Construction.

CLEVELAND, *Bradley Co.* (Pop., 1874; est., 3,000.) Has manufactories.

Proposed Works.—Apr. 5, '90, works were under consideration, but nothing definite reported. Chn., Thos. L. Cate.

COVINGTON, *Tipton Co.* (Pop., 799; est., 2,000.) Trade center. Incorp.

Proposed Works.—Covington Water-Works Co. to build in '90. Supply, spring with yield of 75 galls. per minute, pumping to tank. Est. cost, $5,000; to be raised by subscriptions to stock; village to pay $125 for 5 hydrants. Prest., R. M. Jockett. Secy., J. R. Sloan. Treas., J. T. Garner. Mgr., J. J. Green. Date report, Mar. 8, '90.

ERIN, *Houston Co.* (Pop., 485; est., 800.)

Proposed Works.—Louisville & Nashville R. R. Co. think of putting in works, but not definitely decided latter part of Jan, '90.

FAYETTEVILLE, *Lincoln Co.* (Pop., 2,104; est., 2,500.) On Elk river. Has manufactories and electric lights.

Proposed Works.—Mar. 25, '90, 30-years franchise, with guarantee of $1,500 per year for 30 hydrants, was granted to Fayetteville Water-Works Co. Supply, either from Elk River, by pumping to 1,000,000 reservoir, or by springs on Pea Ridge, 4 miles from town, by gravity to and from reservoir. If from former source there will be two 1,000,000-gall. pumps and two boilers. Reservoir site is 1¼ miles from and 210 ft. above river and 30 ft. below springs. Distribution will consist of about 4½ miles 10 to 4-in. pipe. Secy., H. K. Bryson.

FRANKLIN, *Williamson Co.* (Pop., 1,632; est., 2,500.) Is 19 miles from Nashville. Has electric lights.

Proposed Works.—Apr. 5, '90, P. E. Cox stated that he had received proposals to put in plant with 40 hydrants, providing city would grant franchise, which he thought was probable. Supply, creek.

HUMBOLDT, *Gibson Co.* (Pop., 1,572; est., 2,000.) Is 17 miles from Jackson. Manufactures wagons and plows.

Proposed Works.—Address E. W. Tug, Mayor. Unofficially reported, spring of '90, that C. Howard, Memphis, was interested.

JOHNSON CITY, *Washington Co.* (Pop., 685; est., 3,000.) Has manufactories.

Proposed Works.—See MANUAL for '88, p. 291; this project seems to have been abandoned. Unofficially reported in early part of '90 that franchise had been granted to R. A. Johnson, 45 Broadway, N. Y. City, and that he had let contract for works to Young & Co., Philadelphia.

McMINNVILLE, *Warren Co.* (Pop., 1,241; est., 1,800.) Has manufactories. Summer resort. Has electric lights.

Present Supply.—Source not given, pumping with windmill to cisterns. Used principally for water supply and sprinkling streets. Would be useful in case of fire.

Proposed Works.—Early in '90 franchise was granted to J. M. Burger, providing that construction be started within 3 months and completed within a year; no pipe smaller than 6 ins. to be used; reservoir with 75,000 galls. cap., or more.

MORRISTOWN, *Hamblin Co.* (Pop., 1,350; est., 2,000.) Near Holston river. Manufactures flour, sash and blinds.

Proposed Works.—Project described in MANUAL for '88, p. 291, not carried out. Unofficially reported latter part of March, '90, that J. J. & T. V. French were interested in plan to introduce water.

NEWBERN, *Dyer Co.* (Pop., 506; est., 2,000.)

Proposed Works.—Town has 6-in. wells, from which it is proposed to pump to tank or stand-pipe. Surveys have been made. Secy Water Com., J. Ira Jones. Date report March 10, '90.

SHERMAN HEIGHTS, *Hamilton Co.* (Pop., est., 1,000.) Is 2 miles from Chattanooga.

Proposed Works.—East Chattanooga Land Co. interested. Supply, large spring. Report from W. A. Woolson; date, about Jan. 1, '90.

TULLAHOMA, *Coffee Co* (Pop., 1,083; est., 3,000.) Has various manufactories. Incorp. town. Partially sewered. Has electric lights.

Proposed Works.—Under consideration since '88 or earlier. Supply, springs, pumping to reservoir. City Recorder, Geo. W. Davidson. See MANUAL for '88, p. 291.

UNION CITY, *Obion Co.* (Pop., 1,879; est., 4,500.) Has manufactories and electric lights.

Proposed Works.—Mar. 10, '90, franchise and contract had been offered to Henry Hungerford, N. Y. City, he having 30 days to accept same, and till Jan. 1, '91, to construct works. Supply, wells, pumping to stand-pipe. To be 8 miles of mains, and 80 hydrants. Est. cost, $80,000. Contract also includes electric lighting plant. Mayor, J. Waddell.

WARTRACE, *Bedford Co.* (Pop., 468; est., 1,200.)

Proposed Works.—Town may lay 2-in. pipe from R. R. tank for fire protection. Date report, Feb. 28, '90.

Water-Works Projects Reported in '89 and '90, but now Indefinite.

Collierville, Shelby Co. *Gallatin*, Sumner Co.; see MANUAL for '88, p. 291. *Lawrenceburgh*, Lawrence Co. *Loudon*, Loudon Co. *Pulaski*, Giles Co.

KENTUCKY.

Water-Works Completed or In Process of Construction.

BELLEVIEW, *Christian Co.* (Pop., est., 3,000.) Incorp. No sewers or electric lights.

History.—Built in '87 in by Belleview Water and Gas Co., taking supply from Newport water-works. Contract with Newport gives an exclusive right to water for 25 years at 7 cents per 1,000 galls.

Water Supply.—Newport water-works, as stated above.

Distribution.—*Mains*, c. i., 10 miles. *Services*, lead. *Taps*, 450. *Meters*, 2. *Hydrants*, kind not given. 50.

Consumption and *Pressure*, not given.

Financial.—(For '87.) Cost, $35,000. Bonded debt, on water-works, $7,000. Int., 6%. Ann. op exp., withheld, est., $1,500. Ann. rev.: consumers, withheld, est., $5,000; city, $1,000. Hydrant rental, $30 to $45.

Management.—Prest., Chas. W. Baker. Supt., Secy. and Treas., G. R. Harmes.

BOWLING GREEN, *Warren Co.* (Pop., 5,114; est., 8,500.) On Barren river, at head of navigation, surrounded by hills 5 to 8 miles distant. Surface rock is limestone, but river rises in sandstone region, and water contains little lime. Much of drainage of valley flows off through caverns in subsoil, which is heavy red clay. Has manufactories. Settled in 1787; incorp. a town in 1797. No sewers. Has electric lights.

History.—Built in '68 by town. Des. Engr., Chas. H. Hermany, Louisville.

Water Supply.—Barren river, pumping to reservoir. Stand-pipe projected in '89.

Pumping Machinery.—Dy. cap., 2,800,000 galls.; one comp., cond.; one high-pressure engine; one is a Worthington. First pump, vertical, 9 x 30-in.

Reservoir.—Cap., 1,000,000 galls.; 237 ft. above pumps.

Distribution.—*Mains*, c. i., 10¼ miles. *Services*, galv. i., lead. *Taps*, 882. *Meters*, 45. *Hydrants*, Mathews, 75. *Valves*, Whittier.

Consumption, 400,000 galls. *Pressure*, 77 lbs.

Financial.—Cost (in '87), $100,000. Debt $90,000. Int., 5 and 6%. Ann. op. exp., $4,000. Ann. rev.: consumers $13,500; city, none.

Management.—Six Comrs. Prest., Jno. Demuth. Secy., G. S. Hollingsworth Supt., Jas. H. Wilkinson.

CENTRAL CITY, *Muhlenburg Co.* (Pop., est., 1,600.) Engaged in coal mining and manufacturing. Incorp. town. No sewers or electric lights.

History.—Built in '89 by Central City Water Co.; put in operation Jan. 1, '90. Engr. T. C. du Pont. Contrs., Central Coal & Iron Co., Central City.

Water Supply.—Green river, pumping to reservoir.

Pumping Machinery.—Dy. cap., not given; Deane.

Reservoir.—Cap., est., 250,000 galls; 50 ft. sq., 15 ft. deep.

Distribution.—*Mains*, 8 to 3-in. c. i., 2 miles. *Services*, 2 and 1-in. w. i. *Hydrants*, 15.

Financial.—Cost, $40,000. Cap. stock, $40,000. Bonded debt, $30,000. Int., 6%. Hydrant rental, $50.

Management.—Prest., Jno. R. Collins. Secy., Wm. H. Clarke. Reports, Sept. 5, '89, about Jan. 1, '90.

COVINGTON, *Kenton Co.* (Pop., 29,700; est., 38,000.) On south bank of Ohio, at mouth of Licking river, opposite Cincinnati, and on nearly level ground. Has manufactories and commerce. Incorp. village in '15, city in '34. Has sewers and electric lights.

History.—Built in '68-70 by city. Des. Engr., Birdsall Holly. Const. Engr., Wm. C. Weir. In '87-90 new works built by city, including new reservoirs and extensive change in distributing mains. Consult Engr., Geo. Bouscaren, Cincinnati, O. Resident Engr., A. Petry. Jan. 22, '90, one of the reservoirs was filled for the first time; cap., 16,000,000 galls. The 27,000,000-gall. reservoir was to be finished in spring of '90, and third reservoir later. See New Works, below.

OLD WORKS.

Water Supply.—Ohio river, by direct pumping. Water first taken from well formed by sinking 18-ft. w. i. tube 71 ft. through gravel on river bank. In bottom of well 35 3-in. pipes were driven 12 ft. Pumps were placed on plate-iron floor 16 ft. above bottom of well. Well failed to furnish necessary amount of water some years ago, and water has since been taken directly from river.

Intake Pipe.—Diam., 20 ins.

Pumping Machinery.—Dy. cap., 5,000,000 galls.; first pumps were in well there being a gang of 12 piston pumps, and two rotaries, driven by two piston and one rotary engine, all furnished by Holly Mfg. Co. Rotary engine and pumps were replaced by McGowan engine and piston pumps.

Distribution.—*Mains*, 20 to 4-in. c. i., 30 miles. *Services*, lead. *Taps*, 2,946. *Meters*, none. *Hydrants*, kind not given, 230.

Consumption, 2,500,000 galls. *Pressure*, 30 lbs.

Financial.—Cost, $500,000. Debt (in '87), $300,000. Int., 7%. Ann. op. exp., $24,000. Ann. rev.: consumers, $35,000; city, none. These figures are *for old works*.

Management.—Prest., C. J. Fronter. Secy., N. T. Lindsay. Treas., G. H. Davidson. Supt., W. H. Glore.

NEW WORKS.

NOTE.—Full description of new works given in MANUAL for '88, and will be given again, in future issue, after completion.

FRANKFORT, *Franklin Co.* (Pop., 6,958; est., 8,250.) On Kentucky river, 29 miles from Lexington; on elevated plane between river and bluff rising 150 ft. River is in deep limestone channel. Manufactures lumber, whiskey and twine. Incorp. in 1786. Has sewers and electric lights.

OLD WORKS.

General Description.—Built in '41 by town, after plans by James Judge, taking supply from spring, by gravity.

Spring is 33 ft. above and 2½ miles from town, and in '82 a 6-in. pipe led from it to a distributing reservoir of stone masonry, 30 x 80 ft., x 6 ft. deep. Stone dam was built ¾ miles from spring to form storage reservoir, and a 12-in. pipe laid from it to town. Dam was 200 ft. long, 35 ft. high, 10 ft. wide at bottom and 3 ft. at top. It leaked too badly for use, and pipe was so poorly laid that it was never brought into service. Distribution was by 4 and 3-in. c. i. pipe; there were no fire hydrants, 8 gates, 500 taps; services of lead and iron.

PRESENT WORKS.

History.—Built in '84-6 by Frankfort Water Co., under perpetual charter. Engr., Chas. Hermany, Louisville.

Water Supply.—Kentucky river, pumping to reservoir.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; Gaskill, comp., single-acting, vertical, plunger; also 1,500,000, Worthington. *Boilers:* tubular.

Reservoir.—Cap., 5,000,000 galls.; depth, 16 ft.; in two compartments, each 116 x 140 ft. at bottom. Contrs., W. F. Shanks and J. Jamison, Louisville.

Distribution.—*Mains*, c. i., 12 miles. *Services*, galv. i., lead. Pipe and specials from Dennis Long & Co., Louisville. *Taps*, 615. *Meters*, 20. *Hydrants*, Mathews, 105. *Valves*, Whittier.

Consumption, 500,000 galls. *Pressure*, 125 lbs.

Financial.—Cost, $200,000. Cap. stock, $150,000. Bonded debt, $17,000. Int., 6%. Ann. op. exp., $4,760. Ann. rev.: consumers, $11,000; city, $6,250. Hydrant rental, $62.50.

Management.—Prest., J. S. Johnson. Secy., A. H. McClure. Supt., Jno. D. Griffin.

GEORGETOWN, *Scott Co.* (Pop., 2,061; est., 3,500.) No sewers. Electric lights projected in '89.

History.—Built in '89 by Georgetown Water Co., under perpetual franchise; put in operation in Oct. Engr., Jno. Nichols. Labor done Co.

Water Supply.—Royal spring, direct pumping.

Pumping Machinery.—Dy. cap., not given; from Laidlaw & Dunn, Cincinnati, O.; two dup., 16x10½x10 ins. *Boilers*, from Robt. Jones & Son.

Distribution.—*Mains*, 8 to 4-in. c. i., 4½ miles; from Dennis Long & Co., Louisville. *Hydrants*, Chapman, 60. *Valves*, Ludlow.

Pressure: Ordinary, 25 lbs. Fire, 80 lbs.

Financial.—Cost, $50,000. Cap. stock, $100,000. Bonds, $35,000. Hydrant rental, $1,500 for all, or $30 each; 15-years contract.

Management.—Prest., R. A. Mitchell. Secy. and Supt., Jno. Nichols. Treas., E. H. Patterson. Report, July 31, '89.

GLASGOW, *Barren Co.* (Pop., 1,510; est., 3,000.) No sewers.

History.—Built in '82 by Glasgow Water Co. Contrs., Fairbanks, Morse & Co., Chicago, Ill.

Water Supply.—Spring, pumping to reservoir.

Reservoir.—Cap., about 100,000 galls.

Distribution.—*Mains*, 4-in., length not given. *Taps*, withheld. *Hydrants*, 6.

Financial.—Cost, $10,000. Capital stock, $10,000. No debt. Ann. op. exp., $800. Ann. rev.: consumers, withheld, city, about $1,200.

Management.—Prest., W. L. Porter. Secy., Treas. and Supt., T. P. Dickinson.

HENDERSON, *Henderson Co.* (Pop., 5,365; est., 10,000.) On east bank of Ohio river on gently undulating ground. Manufactures cotton and woolen goods, flour, whiskey and tobacco. Settled in 1797; incorp. town in '10, city in '67. No sewers or electric lights.

History.—Built in '74-6 by city. Des. Engr., Thos. J. Whitman. Const. Engr., Gaston M. Alves.

Pump-Well.—Is 8x15 ft. x 39 ft. deep, with stone walls 9 ft. thick at bottom and battered on outside to 4 ft. at top.

Water Supply.—Ohio river, pumping to reservoir and stand-pipe.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; 1,500,000 from Gerald, Allen & Co.; 1,500,000 Gordon & Maxwell, added in '88; former beam and fly-wheel engine with 20x60-in. cylinder, and two single-acting, 14½-in., plunger pumps.

Reservoir.—Cap., 3,000,000 galls.; in excavation and embankment; 70 ft. above business part of city, 148 above bottom of pump-well. Inner slopes, 1½ to 1, covered with 2 ft. of puddle, paved with 9 ins. of hard brick in cem. mortar; outer, 1¾ to 1. Bottom covered with 18 ins. of puddle, then 5 ins. concrete made of broken bats and cem. mortar. Excavation at bottom in sand, and puddle was placed upon this. At first there was considerable leakage, but after four months this greatly diminished.

Stand-Pipe.—On bank of reservoir, 5x80 ft.

Distribution.—*Mains*, c. i., 12½ miles. *Services*, galv. i. *Taps*, 859. *Meters*, 10. *Hydrants*, Bailey, Mathews, 70. *Valves*, Eddy.

Consumption, 500,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 70 lbs.

Financial.—Cost, $175,000. Debt, $113,000. Int., 5 and 6%. Sinking fund: "all special license receipts from wharf go into sinking fund to pay principal, while an ad valorem tax is levied to pay interest." Ann. op. exp., $4,000. Ann. rev.: consumers, $14,000; city, none.

Management.—Comrs. Chn., I. F. Mayer. Secy. and Treas., R. C. Blackwell. Supt. and Pumping Engr., Jas. P. Wigal.

LEBANON, *Marion Co.* (Pop., 2,054; est., 3,000.) Incorp. No sewers or electric lights.

History.—Built in '88-9 by city; put in operation Sept. 15, '89. Engrs., J. D. Cook, L. E. Chapin, Toledo, O.; Contrs., Scovel & Irwin Construction Co., Nashville, Tenn.

Water Supply.—Rolling Fork creek, pumping either from filter gallery or direct from stream to reservoir.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Gordon, comp., dup., cond. *Boilers*: from Union Iron Works, Chattanooga, Tenn.

Force Main.—Of 8-in c. i., 8,000 ft. long; rise, about 480 ft.

Reservoir.—Cap., 756,000 galls.; 471 ft. above pump, 290 above town; in excavation, 10 ft., embankment, 11 ft.; no heart-wall; 105 ft. in diam. at top, 80 at bottom; banks of earth, 20 ft. wide at top inner slope, ¾ to 1, paved with 18-in. stone at bottom, 12-in. at top, then covered with 2-ins. cement mortar; outer slope, 2½ to 1. *Drain-pipe:* 10-in. Does not leak. Built in '89. Des. Engrs. and Contrs., see History. Supt. Const., W. F. Goodnow. Cost, $5,000.

Supply Main.—C. i., 10-in., $12,000 ft. long.

Distribution.—*Mains*, 10 to 6-in. c. i., 9 miles; from Dennis Long & Co., Louisville. *Services*, lead. *Taps*, 80. *Meters*, Hersey, 1. *Hydrants*, Bourbon, 43.

Consumption, 50,000 galls. *Pressure*, 120 lbs.

Financial.—Cost, $60,000. Cap. stock, $60,000. Debt, $58,500. Bonds, $60,000. Int., 6%. Ann. op. exp., est., $2,500. Ann. rev.: city, pays interest on bonds. Hydrant rental, nominal.

Management.—Prest., Andrew Offutt. Secy., January Grun Treas., J. M. Knott. Supt., Jno. Rubel.

LEXINGTON, *Fayette Co.* (Pop., 16,656; est., 26,000.) On north branch James river, on irregular ground. Has manufactories. Settled in 1735; incorp. in 1778. No sewers Has electric lights.

OLD WORKS.

General Description.—Built in '32 by city, taking water from springs collected in reservoir 25 x 15 ft., holding 55,080 galls. Reservoir was 265 ft. above river, 62 ft. above highest point on Main St. At end of '82 there were 3 miles of 3-in. c. i. distributing mains, 9 hydrants, 400 taps.

PRESENT WORKS.

History.—Built in '84 by Lexington Hydraulic & Mfg. Co. Des. Engr., J. D. Cook, Toledo, O. Const. Engr., S. A. Charles, Supt. Contr. for masonry and buildings, L. B. Stevens, Toledo, O. Another dam and reservoir projected in '89.

Water Supply.—Surface water, direct pumping from impounding reservoir.

Dam and Reservoir.—Cap., 95,000,000 galls.; area, 40 acres; 20 ft. water. Dam of clay, rolled in 6-in. layers while wet; has heart-wall; founded on rock: 550 ft. long, 24 ft. high, 12 ft. wide on top. Inner slope, 2 to 1, paved; outer, 1½ to 1, unpaved. *Heart-wall:* puddle, 20 ft. high. *Spillway:* beginning 100 ft. above dam; carried round 100 ft. from end; 4 ft. deep; in rock, partly lined with masonry, free; slope, 1 ft. in 16. *Discharge-pipe:* 24-in. Does not leak badly. Built in '84. Engrs., see History. Contrs., Mason & Fiard, Frankfort.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two 1,500,000 Gaskill horizontal.

Distribution.—*Mains*, c. i., 18 miles. *Services*, lead. Pipe and specials from and laid by M. Philbin, Chicago, Ill. *Taps*, 630. *Meters*, 357. *Hydrants*, Holly, 239. *Valves*, Ludlow.

Consumption, 750,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—Cost, withheld, est., 350,000. Cap. stock, $250,000. Bonded debt, $235,500: $210,500 at 6, and $25,000 at 7%. Ann. op. exp., $8,000. Ann. rev.: consumers, $12,000; city, $11,950. Hydrant rental, $50, hydrants to be set not more than 300 ft. apart.

Management.—Prest., C. G. Hildreth, 45 Broadway, N. Y. City. Treas. and Supt., S. A. Charles.

LOUISVILLE, *Jefferson Co.* (Pop., 123,758; est., 165,000.) On south bank of Ohio river, on elevated plateau 70 ft. above low water in river. Settled in 1775: incorp. city in '41. Has sewers and electric lights.

History.—Built in '57-60 by Louisville Water Co., city owning greater part of stock. Co. chartered in '54; Sept. 6, '56, city was authorized by popular vote of 1,415 to 370 to subscribe for $550,000 of Co.'s stock, and to issue bonds to that amount In '77 large storage reservoir was built, and in '88-90 new pumping station constructed. Engr. of works to '61 was Theo. R. Scowden; since '61, Chas. Hermany has been Chf. Engr. and Supt.

Water Supply.—Ohio river, pumping to reservoir, stand-pipe and direct. Water is taken from river, 1.52 miles above city limits, shore at this point being of sand and coarse gravel.

Intake Pipe.—W. i., 50-in., 300 ft. long, set in timber crib filled in with stone. Mouth is 5 x 12 ft., 1 ft. below extreme low water.

In '65 this pipe was half filled with silt, which in '66 gave so much trouble that a well was sunk over it, 105 ft. from end, intention being to clean it. High water stopped work till '67, when pipe was cleaned. Its outside was sound, but there were tubercles on inside, deepest corrosion being 1-16 in. Dec., '70, anchor ice stopped pumps, and strainer had to be removed temporarily; in '74 floating leaves caused another stoppage. In '77 pipe was again cleaned, 20 ins. of silt having accumulated. This time top of inside of pipe was found to be corroded in some places to depth of ¼ in.

Pumping Machinery.—Dy. cap., 21,000,000 galls.; Blake, driven by Cornish beam engines. Large additional pumping plant was contracted for in '88, and will probably be completed in '90: 16,000,000-gall. pumps, built by J. P. Morris & Co., Philadelphia. Engine-house and engine foundations consist of timber caisson 81.5 ft. sq., 16 ft. deep, sunk in river 24 ft. below low-water mark.

Stand-Pipe.—Of ⅛ to ¼-in. plate-iron, 4 ft. in diam., 132 ft. high above ground, which is 41 ft. above low water in river. Wooden tower enclosed stand-pipe. An attempt to pump directly to mains in '70 resulted in a ram which broke a 30-in. main. In '75 arrangement was made by which water from stand-pipe overflowed into four

20-in. pipes instead of feeding mains from its base. This enabled water to pass into distribution mains without passing through reservoir.

Old Reservoir.—Cap., 10,000,000 galls.; water surface, 175 x 374 ft.; depth, 19.4 ft.; 41 ft. above low water in river. Dividing wall, 12 ft. high, was built, through which force main rose to 144 ft. above low water, discharging through bell mouth. In '69 second force main was laid to chamber, from which it discharged over weir, 10 ft. long. Bottom of reservoir is paved with two courses of brick in cem., laid flat, and slopes with one course, on edge; 9-in. inverted brick arch connects bottom and slope.

For description of breaks and of cleaning reservoir see MANUAL for '88, pp. 296–7.

Crescent Hill Reservoir.—Cap., 100,000,000 galls. Begun in Apr., '77, and water admitted Dec. 15, 79. Is 2½ miles from stand-pipe and 175 ft. above low water in river. Reservoir was built with great care, but leaks and slips occurred soon after it was filled.

Distribution.—(For '87.) *Mains*, c. i., 137.4 miles. Since '68 all pipe has been coated with Angus Smith's preparation. *Services*, galv. i., lead. *Taps*, 11,001. *Meters*, 678; these were first put in use in '62. *Hydrants*, kind not given, 147. *Cisterns*, 437.

Consumption (in '87), 10,307,056 galls. *Pressure:* Ordinary, 35 lbs. Fire, 50 lbs.

Financial.—(For '87.) Cost, $5,008,809. Cap. stock, $1,275,100. Bonded debt, $900,000. Int., 6%. Ann. op. exp., $59,258. Ann. rev.: consumers, $256,556; city, none.

Management.—Directors. Chf. Engr. and Supt., Chas. Hermany.

Reference.—Tenth Census U. S., vol. XVII., Water Supply of American Cities, pp. 80–2.

NOTE.—No data for '88.

MAYFIELD, *Graves Co.* (Pop., 1,839; est., 4,000.) Incorp. city. No sewers or electric lights.

History.—Built in '89-90 by Mayfield Water & Light Co.; Mar. 6, '90, it was expected works would be in operation in June. Des. Eng., Thos. Middleton. Contrs., Commonwealth Const. Co., Philadelphia, Pa.

Water Supply.—Deep wells, pumping to tank.

Pumping Machinery.—No data.

Stand-Pipe.—Cap., 150,000 galls.; 14x130 ft.

Distribution.—*Mains*, c. i., 5¾ miles; laid by Jno. Foley, Nashville, Tenn.

Financial.—Cost, est., $35,000 to $40,000. Cap. stock, authorized, $100,000. Bonds, authorized, $50,000. Hydrant rental, $3,000 for all.

Management.—Prest., L. Anderson. Secy., D. P. Coulter. Supt., B. A. Neale. Report, Mar. 6, '90.

MAYSVILLE, *Mason Co.* (Pop., 5,220; est., 8,000.) On Ohio river, in uneven country. Has manufactories. Settled in 1785; incorp. city in '25. Partially sewered. No electric lights.

History.—Built in '80 by Co. Des. Eng., Travers Daniel, deceased.

Water Supply.—Ohio river, pumping to reservoir.

Pumping Machinery.—Dy. cap., 3,500,000 galls.; two Blake, one with 16, and one with 19¾-in. cylinders, of 36-in. stroke. Pumps are in well 15 x 50 ft.

Reservoir.—Cap., 3,000,000 galls.; in two basins, 418 ft. above pumps, 425 ft. above low water in river.

Distribution.—*Mains*, c. i., 11 miles. *Services*, lead, galv. i. Pipe and specials from Dennis Long & Co., Louisville. *Taps*, 650. *Meters*, 75. *Hydrants*, Mathews, 51. *Valves*, Eddy.

Consumption, 300,000 galls. *Pressure*, av., 155 lbs.

Financial.—Cost, $150,000. Cap. stock, $100,000. Bonded debt (in '87), $50,000. Int., 6%. Ann. op ex., $6,000. Ann. rev.: consumers (in '87), $12,000; city, nothing, it having paid $50,000 for perpetual fire protection when works were constructed.

Management.—Prest., Jacob Toreger. Secy., A. R. Cooper. Louisville. Supt. and Pumping Engr., A. Schaeffer.

MIDDLESBOROUGH, *Bell Co.* (Pop., not given.) Has electric lights.

NOTE.—Middlesborough Town Co. began supplying residents from artesian well in '89. Jan. 10, '90, preparations were being made to increase supply by adding 12,000 galls. per day from a mountain stream. Secy. and Treas., J. B. Cary. Report by C. W. Loverin, in charge of water supply.

NEWPORT, *Campbell Co.* (Pop., 20,413; est., 27,500.) On south bank of Ohio river, opposite Cincinnati, O., separated from Covington by Licking river on the west. Has large pipe and other manufactories. Settled in 1791. Incorp. No sewers. Has electric lights.

History.—Built in '72 by city when pop. was about 16,000. Engr., Theodore R. Scowden; succeeded by George Hornung.

Water Supply.—Ohio river, at point 4 miles above city, pumping to reservoir.

Pumping Machinery.—Dy. cap., 5,000,000 galls.; 1,000,000 Cope & Maxwell, two 2,000,000 vertical Gaskill.

Force Main.—For first 1,445 ft. rises 350 ft., and is of 20-in. c. i. From crest of bluff pipe changes to 24-in. for 250 ft., then to 20-in. for 4,318 ft., in which distance it falls 56 ft., finally discharging into reservoir.

Reservoir.—Cap., 40,000,000 galls; area, 14 acres; formed by clayey earth dam across junction of two ravines, divided by embankment Dam, without heart-wall, about 500 ft. long, 35 ft. high, 20 ft. wide on top. Slopes both 1¾ to 1, inner paved with 12 ins. of limestone on edge, outer unpaved. Division wall 20 ft. high, 10 ft. wide on top; slopes 1¾ to 1. *Drain and Effluent Pipes:* surrounding surface drainage is carried beneath reservoir in 24-in. pipes, meeting in 36-in. pipe which passes under dam with stone collars 8 ft. sq. and 2 ft. thick, every 12 ft.; originally two 30-in. effluent pipes were laid through dam, connecting with 20-in. supply main in city. In '88 new effluent-pipes were laid, that from South basin passing in tunnel beneath division bank; both pass beneath dam in oval tunnel, through solid rock, 7 ft. high, 9 ft. wide, lined with brick masonry.

June 17, '75, North basin was rapidly emptied, and slopes slid in. On examination half drain pipes were found broken. They were stopped up, surface drains made, and banks repaired. Later, inner slope of main embankment fell in, and paving has not yet been removed from bottom of reservoir. Effluent pipes were laid in fill which was only partially settled, result being leakage. Main embankment was built to hold 30 ft. of water, but as division embankment is but 20 ft. high reservoir cannot be filled without doing away with clear water basin. On account of broken embankment and leaky effluent pipes it is not considered safe to store more than 20 ft. of water in either basin.

Steps were taken in '88 to put reservoir in shape, first contracts being for changing effluent pipes, as described above. Built in '73. Des. Engr., T. R. Scowden. Const. Engr., L. A. Scowden. Contrs., T. & M. Cooper, Newport. Cost, $130,000.

Distribution.—*Mains*, c. i., 27 miles. *Services*, lead. *Taps*, 3,473. *Meters*, Worthington, Crown, 89. *Hydrants*, Bourbon, 160. *Valves*, Cummings, Eddy, Bourbon. *Close of '80*: Mains, 20.45 miles. Taps, 1,582. Meters, 16. Hydrants, 175.

Consumption, 900,000 galls. *Pressure*, 80 lbs.

Financial.—Cost, $889,379. Bonded debt, $800,000. Int., 7.3%. Sinking fund, $24,000. Ann. op. exp., $11,063. Ann. rev.: consumers, $34,979; city, none. Water rents, '73, $226; do., '74, $7,191; do., '80, $17,759. Cost, close of '80, $696,342.

Management.—Four Trustees. Prest., A. D. Berry. Secy., Jas. Betz. Treas., J. H. Smith. Supt., B. R. Morton.

OWENSBOROUGH, *Daviess Co.* (Pop., 6,231, est., 11,500.) On Ohio river. Has large and numerous tobacco and whiskey manufactories, and woodworking shops. Settled in '16; incorp. city in '66. Has sewers and electric lights.

History.—Built in '79 by Owensboro Water Co. Contrs., Denison & Cowell Muscatine, Ia.

Water Supply.—Ohio river, by direct pumping.

Pumping Machinery.—Dy. cap., 5,000,000 galls.; three Holly-Gaskill; first two of 25 x 28-in. steam, 14-in. water cylinders; in '88 a 2,500,000 Gaskill vertical was added. In '89 contracts were let for 5,000,000 Buffalo pump.

Distribution.—*Mains*, c. i., 16 miles. *Services*, galv. i., lead. *Taps*, 700. *Meters*, 30. *Hydrants*, Holly, 126.

Consumption, 1,000,000 galls. *Pressure:* Ordinary, 55 lbs. Fire, 125 lbs.

Financial.—Cost, withheld, est., $250,000. Cap. stock (in '82), $80,000. Bonded debt (in '88), $100,000. Int., 6%. Ann. op. exp., withheld, est., $12,000. Ann. rev.: consumers (in '86), $4,500; city (in '87), $6,300.

Management.—Prest., S. A. Miller, Louisville. Secy., Wm. Reinecke, Louisville. Supt. and Pumping Engr., Henry P. Martin.

PADUCAH, *McCracken Co.* (Pop. 8,036; est., 18,000.) At junction of Ohio and Tennessee rivers. Has manufactories, and large river and tobacco trade. Incorp. No sewers. Has electric lights.

History.—Built in '86 by Paducah Water Supply Co., of Baltimore, Md., and sold March 1, '88, to Paducah Water Co., of Paducah. Latter company was chartered by Legislature, Feb. 20, '88, under 20-years franchise. Engr., E. F. Fuller. Contr., Saml. R. Bullock & Co. Both of N. Y. City.

Water Supply.—Ohio river, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 4,000,000 galls.; two 2,000,000 Gaskill vertical, one being a high-pressure.

Stand-Pipe.—Cap., 497,000 galls.; 22 x 175 ft.

Distribution.—*Mains*, c. i., 14½ miles. *Services*, not given. *Taps*, 1,000. *Meters*, 4. *Hydrants*, Pattee & Draper, 164. *Valves*, kind, do.

Consumption, 500,000 galls. *Pressure:* Ordinary, av., 60 lbs. Fire, 200 lbs.

Financial.—Cost, $192,188. Cap. stock, $150,000. Bonded debt, $150,000. Int., 6%. Ann. op. exp., $8,500. Ann. rev.: consumers, $14,920; city, $6,480. Hydrant rental, $40 for first 150, $30 for next 30, $25 for all additional.

Management.—Prest., H. Burnett. Secy., L. M. Ricke. Supt. and Treas., M. Burnett.

PINEVILLE, *Bell Co.* (Pop., est., 1,200.) Engaged in iron and coal mining. Incorp. Has sewers. No electric lights.

History.—Built in '88 by Pineville Water Co., under perpetual franchise; completed about Oct. 1, '89. Engr., Emil Mahlo. Contr., Jno. Cosgrove, Pineville.

Water Supply.—Mountain streams. Source about 400 ft. above, 3 miles from town. Reservoir for reserve.

Reservoirs.—Cap., about 150,000 galls.; 35 x 51 ft. at top, 24 x 45 at bottom, 15 ft. deep. Formed by coursed rubble sandstone walls in Portland cem., 10½ ft. thick at bottom, 4½ at top; batter, 1 to 5, both sides. Built in '89. Des. Engr. and Contr., see History. Const. Engr., W. W. Duffield, Pineville.

Distribution.—(May 1, '89.) *Mains*, 4 to 8-in. c. i., 5 miles. *Taps*, 60. *Meters*, not given. *Hydrants*, Mathews, 11. *Valves*, Ludlow.

Consumption, not determined. *Pressure*, 90 lbs.

Financial.—Cost, $25,000. Cap. stock, $12,500. Bonded debt, $12,500. Int., 6%. Ann. op. exp., "nominal." Ann. rev.: not determined. Hydrant rental, $15; 3-years contract.

Management.—Prest., F. A. Hull, Danbury, Conn. Secy., H. C. Lee. Treas., M. J. Moss. Supt., J. F. Willson.

PLEASANT HILL, *Mercer Co.* (Pop., est., 200.) In blue-grass region.

History.—Built in '33 by "United Society of Shakers," and now known as works of Mercer Water Co. System supplies "four large families" with water. The four families consist of 150 persons.

Water Supply.—Spring, pumping to tank. Dy. flow of spring, 5,500 galls.

Pumping Machinery.—Old fashioned force pump, with 5-in. discharge, made in '33, and worked by one or two horses; raises water 120 ft.

Tank.—Cap., 4,482 galls.; wooden.

Distribution.—*Mains*, c. i., 1½ miles. *Services*, lead. *Taps*, 15. *Meters* and *Hydrants*, none.

Consumption, 4,000 galls. *Pressure*, head of 120 ft.

Financial.—Cost $1,500. No debt. Ann. op. exp., $150. No rev.

Management.—Supt., Jno. A. Van.

Water-Works Projected with Fair Prospects of Construction.

CATTLESBURGH, *Boyd Co.* (Pop., 1,225; est., 4,000.) On Ohio river.

Proposed Works.—Apr. 22, '89, C. W. Berger stated that preliminary surveys had been made by L. W. Lete, Huntington, W. Va. Supply, Ohio river, pumping to reservoir 1,400 ft. distant. Mains, 3½ miles. Contracts could not be let till after Jan., '90, as act of Legislature was necessary. No later data.

HICKMAN, *Fulton Co.* (Pop., 1,264; est., 2,500.) Trade center.

Proposed Works.—Oct. 5, '88, City Council had previously appointed Com. to report on works. Est. cost, $2,500 to $4,000. Chn., Geo. Warner.

HOPKINSVILLE, *Christian Co.* (Pop., 4,229; est., 8,000.) Incorp. city. No sewers or electric lights.

Proposed Works. City to complete works by July 1, '90. Contracts had not been let Jan. 5, '90. Des. Engr., A. H. Kennedy, Rockport, Ind. Supply, Little river dam, pumping to stand-pipe, 20 x 100 ft., by a comp. and a high-pressure pump, 1,500,000 galls. each. Mains, 12 to 4-in. c. i., 9 miles. Hydrants, 75.

PRINCETON, *Caldwell Co.* (Pop., 1,234; est., 2,200.) In coal district. Has manufactories.

Proposed Works.—In '88 or '89 town sunk artesian well about 200 ft. deep in public square. Various projects reported in '89 and early part of '90. Town Clerk, W. B. Perry.

RICHMOND, *Madison Co.* (Pop., 2,909; est., 4,000.)

Proposed Works.—In '89 town wished to build, pumping from wells or lake. Est. cost, $75,000. Address W. B. Smith.

RUSSELLVILLE, *Logan Co.* (Pop., 2,058; est., 3,000.) Has manufactories.

Proposed Works.—Sept. 7, '89, project had been abandoned, owing to deficiency of proposed supply. Unofficially reported, Feb., '90, that petition for charter had been made to Legislature. Address M. B. Bowden or Jno. P. Long.

SHELBYVILLE, *Shelby Co.* (Pop., 2,393; est., 3,500.)

Proposed Works.—Jan. 8, 90, it was intended to secure State charter for works Supply (probably) artesian or surface well. Est. cost., $30,000. Address T. J. Ramsey or L. T. Gruber.

STANFORD, *Lincoln Co.* (Pop., 1,213; est., 3,000.) Has various manufactories. Incorp. city. Electric lights projected in '90.

Proposed Works.—Jan. 30, '90, estimates were being made for works to be owned by city. Supply, 3 large springs, pumping to stand-pipe. City Engr., H. A. Evans.

WINCHESTER, *Clark Co.* (Pop. 1,260; est., 4,000.) About 20 miles from Lexington.

Proposed Works.—Discussed in '89, and still under consideration. Mar., '90. address the Mayor.

Water-Works Projects Reported in '89 and '90, but now Indefinite.

Danville, Boyle Co. *Harrodsburgh*, Mercer Co.; see MANUAL for '88, p. 299. *Highlands*, Lincoln Co. *Mount Sterling*, Montgomery Co. *Nicholasville*, Jessamine Co.; see MANUAL for '88, p. 299. *Paris*, Bourbon Co.; see MANUAL for '88, p. 299.

GROUP 5.—Central Northern States.—Water-Works Completed, in Process of Construction or Projected, in Ohio, Indiana, Michigan, Illinois and Wisconsin.

OHIO.

Water-Works Completed or in Process of Construction.

AKRON, *Summit Co.* (Pop., 16,512; est., 30,000.) On height of land between Lake Erie and Ohio river, 495 ft. above lake, 1,065 above sea. Manufactures matches, flour, crackers, sewer-pipe, pottery, agricultural implements. Settled in '25. Incorp. Has sewers and electric lights.

History.—Built in '80-1 by Akron Water-Works Co., under perpetual charter. Engr., Joseph Flannery. Contrs., M. S. Frost & Son.

Water Supply.—Well in gravel, pumping to reservoir. The well of brick, 50 ft. in diam., 32 ft. deep, with walls from 30 to 18 ins. thick, sunk on c. i. shoe by excavating from inside and letting their weight carry them down.

Pumping House.—See MANUAL for '88, p. 300.

Pumping Machinery.—Dy. cap., 5,000,000 galls.: Worthington.

Force Main.—Originally 2,500 ft. of 16-in. c. i.

Reservoir.—Cap., est., 3,500,000 galls.: 200 x 250 ft., x 15 ft. deep.; in excavation and embankment, lined with 18 ins. of puddle, on which is paving of sandstone blocks in cem.

Distribution.—*Mains*, c. i., 27 miles. *Services*, galv. i. Pipe from Lake Shore Foundry Co., Cleveland; specials from Taplin, Rice & Co., Akron. *Taps*, 1,643. *Meters*, 65. *Hydrants*, Mathews, 197. *Valves*, Chapman.

Consumption, 1,500,000 galls. *Pressure:* 60 to 90 lbs.

Financial.—(In '87.) Cost, $250,000. Cap. stock, $250,000. Bonded debt, $200,000 Int., 6%. Ann. op. exp., $8,000. Ann. rev.: consumers, $8,000; city, $9,500. Hydrant. rental, $45.

Management.—Prest., Frank Adams. Secy., H. C. Starr. Supt. and Pumping Engr., E. A. Lawton.

ALLIANCE, *Stark Co.* (Pop., 4,635; est., 6,130.) On Mahoning river on rolling ground. Engaged in manufacturing. Settled in '33 as Freedom; incorp. as Alliance in '75. Has electric lights.

History.—Built in '83 by Alliance Water-Works Co. Contrs., J. A. Cloud, Philadelphia, Pa.

Water Supply.—Mahoning river, pumping to stand-pipe and direct.

Dam.—Of squared timber cribs, filled in with stone, forming pool from which water is pumped.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two 1,500,000 Worthington. *Boilers:* from Cunningham Iron Works, Boston, Mass.

Stand-Pipe.—Cap., 188,000 galls.; 20 x 80 ft.; from Cunningham Iron Works, Boston, Mass.

Distribution.—(In '87.) *Mains*, c. i., 6 miles. *Services*, galv. i. *Taps*, 271. *Meters*, 25. *Hydrants*, Coffin, 55. *Valves*, Coffin.

Consumption (in '87), 193,291 galls. *Pressure:* Ordinary, 73 lbs. Fire, 100 to 140 lbs.

Financial.—(In '87.) Cost. $145,000. Cap. stock, $75,000. Bonded debt, $70,000. Int., 6%. Ann. op. exp., withheld. Ann. rev.: consumers, withheld. city. $3,360. Hydrant rental, $60.

Management.—(In '88.) Prest., Daniel Runkle. Secy. and Treas., Wm. Runkle, 160 Broadway, N. Y. City. Supt. and Pumping Engr., J. C. Reed.

ASHTABULA, *Ashtabula Co.* (Pop., 4,445; est., 10,000.) On Ashtabula river, 2 miles from Lake Erie. Engaged in manufacturing, and in coal and iron business. Incorp. No sewers. Has electric lights.

History.—Built in '87 by Ashtabula Water Supply Co., under 20-years franchise. Des. Engr., J. H. Whitman. Const. Engr., J. M. Howells. Also supplies Ashtabula Harbor.

Water Supply.—Series of wells and tubes on sandy shore of Lake Erie, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two Worthington. *Boilers:* two 150-H. P. Hazleton.

Reservoir.—Cap., 10,000,000 galls.

Stand-Pipe.—Cap., 235,000 galls.; 20 x 100 ft.; from Tippett & Wood, Phillipsburgh, N. J.

Distribution.—*Mains*, c. i., 14 miles. *Services*, lead, iron. Pipe and specials from Cincinnati & Newport Iron & Pipe Co., Newport, Ky. Trenching and pipe-laying done by Co. *Taps*, 867. *Meters*, 75. *Hydrants*, Ludlow, 100. *Valves*, Ludlow.

Consumption, not given. *Pressure*, 75 lbs.

Financial.—Cost, $320,000. Cap. stock, $250,000. Bonds, $20,000. Sinking fund. $5,000 per annum after 10 years. Int., 6%. Ann. op. exp., withheld. est., $3,500. Ann. rev.: consumers, including railways, $1,700; city, $4,500. Hydrant rental. $45.

Management.—Prest., Theo. Hall. Secy., C. B. Ludwig. 72 Broadway, N. Y. City. Supt., O. B. Clark.

ATHENS ASYLUM FOR THE INSANE, *Athens Co.* (Pop., 900.) At Athens, on Hocking river.

History.—Built in '73-4 by asylum. Des. Engr., Dean Stickney.

Water Supply.—Well, pumping, to reservoir. Well is 26 ft. in diam., 20 ft. deep, in gravel, 600 ft. from Hocking river.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Gordon & Maxwell, placed in '75. Two Deane, formerly reported.

Reservoir.—Cap., about 400,000 galls.; 50 x 150 ft., x 6 ft. deep; in excavation and embankment, 150 ft. above pumps, 100 above asylum.

Distribution.—*Mains*, w. i., 1½ miles. *Services*, c. i. *Taps*, not given. *Meters*, none. *Hydrants*, Chapman, 5. *Valves*, Chapman.

Consumption, 125,000 galls. *Pressure*, 35 lbs.

Financial.—Cost, unknown. No debt or revenue. Ann. op. exp., not given.

Management.—Supt. of Asylum, A. B. Richardson.

AVONDALE, (*Cincinnati P. O.*) *Hamilton Co.* (Pop., est., 4,500.) Suburb of Cincinnati; area, 1¼ sq. m.

General Description.—Pipe laid in '87, and owned by village. City of Cincinnati furnishes water from its tank on Mount Auburn, controls system, collects all rates, and after 20 years, or earlier, is to own distribution system to amount of $75,000, provided that 50% of revenue derived from same be returned to village for that purpose. Address Arthur G. Moore, Supt. and Engr., Cincinnati Water-Works.

BELLAIRE, *Belmont Co.* (Pop., 8,025; est., 12,000.) On Ohio river, 5 miles south of Wheeling, W. Va. Engaged in coal mining, manufacturing. Incorp. Has sewers and electric lights.

History.—Built in '72 by city. Engr., Jos. L. Lowry, Pittsburgh, Pa.

Water Supply.—Ohio river, pumping to reservoir.

Pumping Machinery.—Dy. cap., 5,000,000 galls.; one from J. L. Lowry, one from Epping, Carpenter & Co ; both of Pittsburgh, Pa.

Reservoir.—Cap., 3,000,000 galls.; semi-circular, 190x95 ft.; one mile from, 216 ft. above, pumps, 165 ft. above main part of city. Has puddled banks and 4-in.-brick lining.

Consumption, 3,000,000 galls. *Pressure*, 65 lbs.

Distribution.—*Mains*, c. i., Wyckoff wood, 10 miles. *Services*, lead. *Taps*, 2,500. *Meters*, 6. *Hydrants*, Lowry, Mathews, 82. *Valves*, Lowry.

Financial.—Cost, $164,443. Debt, $130,000. Int., 6%. Ann. op. exp., $11,000. Ann. rev.: consumers, $18,000.

Management.—Prest , Geo. Walters. Secy. and Supt., H. G. Wilson.

BELLEFONTAINE, *Logan Co.* ((Pop., 3,998; est., 5,000.) In farming district. Incorp. No sewers or electric lights.

History.—Built in '83 by town.

Water Supply.—*Old:* springs, by gravity. *New:* two 8-in. flowing wells, by pumping. Wells 140 ft. deep, 50 ft. in rock.

Pumping Machinery.—Dy. cap., 1,500,000 galls; two 750,000, added in '89; kind not given.

More's Hill Dam and Reservoir.—Cap., 9,000,000 galls; area, 1 acre. Dam of clay, with heart-wall; 250 ft. long, 23 ft. high, 21 ft. water; 12 ft. wide on top, 100 at bottom. Inner slope paved with 12-in. cobbles; outer, unpaved. *Heart-wall:* brick in cem., 2 ft. thick, extending down 6 ft. from top of spillway. *Spillway:* in center of dam, 30 ft. long, 2 ft. deep, lined with masonry, free; slope, 1½ to 1. *Discharge-pipe:* 16-in. Dam does not leak. Built in '83. Des. Engr , J. D. Cook, Toledo. Const. Engr., J. D. McLaughlin. Contr., W. T. Snyder. Two last of Bellefontaine. Cost, $8,000.

Distribution.—*Mains*, c. i., 7½ miles. *Services*, w. i., lead. *Taps*, 175. *Meters*, 3. *Hydrants*, Mathews, 72.

Consumption, 500,000 galls. *Pressure*, 60 lbs.

Financial.—Cost, $80,000. Bonded debt, $80,000. Int., 6%. Ann op. exp. (in '87), $800. Ann. rev., $2,000. Extensions in '89 cost $20,000.

Management.—Prest., D. Dow. Secy., I. N. Zearing. Supt., C. F. Martin.

BELLEVUE, *Huron Co.* (Pop., 2,169; est., 3,500.) On slightly rolling ground between prairie and swamp. Has railway repair shops and manufactories. Settled in '15; incorp. city in '51. No sewers or electric lights.

History.—Built in '73 by city. Engr., —— McReynolds, Cleveland.

Water Supply.—Surface water, collected in reservoir by ditch draining large area of prairie, then pumped to stand-pipe.

Reservoir.—Cap., 100,000,000 galls.; area, 12 acres; in excavation and embankment, on same level as city. Banks of natural earth, 20 ft. high, 8 ft. wide on top, unpaved. *Culvert:* diam., 3 ft. *Discharge-pipes*, two, 10-in. Does not leak. Built in '71 and '81. Cost, $40,000.

Pumping Machinery.—Dy. cap., 1,100,000 galls.; two Knowles. Contracts let in '89 for 2,000,000 Gordon.

Stand-Pipes.—*Old:* no data. *New:* cap., 235,000 galls.; 20 x 100 ft.; projected in '89.

Distribution.—*Mains*, Wyckoff wood, 3 miles. *Services*, w. i. *Taps*, 186 *Meters*, none. *Hydrants*, kind not given, 23.

Consumption, 500,000 galls. *Pressure*, 18 lbs.

Financial.—Cost, $38,000. Debt, $36,000. Int., 5%. Ann. op. exp., $1,800. Ann. rev.: consumers, $2,500, of which $1,450 is from railways.

Management.—Three Trustees. Secy., Jno. L. Painter. Supt., C. H. Smith.

BROOKLYN, *Cuyahoga Co.* (Pop., 1,295; est., 5,000.) On Cuyahoga river, 3 miles south of Cleveland.

History.—Built in '88 by village. Contrs., L. B. Stanley, Collinwood, and D. B. Fish, Brooklyn Village.

Water Supply.—Cleveland Water-Works, through meter.

Distribution.—*Mains*, 4 to 8-in. c. i., 7 miles. *Services*, lead. Pipe and specials from Lake Shore Foundry Co., Cleveland. *Taps*, 200. *Meters*, Worthington, 47. *Hydrants*, Ludlow, 59. *Valves*, Ludlow.

Consumption and *Pressure*, not given.

Financial.—Cost, $35,000, Debt, $29,000. Int., 6%. Other data not determined.

Management.—Prest., C. Trowbridge. Secy., H. M. Farnsworth, 219 Superior St., Cleveland.

BUCYRUS, *Crawford Co.* (Pop., 3,835; est., 7,000.) On Sandusky river, on quite level land. Has railway shops. Settled in '22; incorp. city in '33. Has sewers and electric lights.

History.—Built in '83-4 by private company under 30-years franchise. Engr., S. V. Saleno, of Michigan Pipe Co., Bay City, Mich., Contrs.

Water Supply.—Well, filtered, by direct pumping. Well is 50 ft. in diam., 20 ft. deep, walled with cut stone.

Pumping Machinery.—Dy. cap., 2,000,000 galls; two Walker, having 14 x 12-in. steam, 18½-in. water cylinders. Contract let in '89 for 1,500,000 Gaskill horizontal crank.

Filters.—Dy. cap., 650,000 galls.; Hyatt; erected Feb., '87.

Distribution.—*Mains*, Wyckoff, 12 miles. *Services*, lead, i., Wyckoff. *Taps*, 325. *Meters*, none. *Hydrants*, Holly; 101 public and 1 private. *Valves*, Galvin.

Consumption, 265,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 80 lbs.

Financial.—Cost, $108,000. Cap. stock, $20,000. Bonded debt, $39,000. Int. 6%. Ann. op. exp., $4,200. Ann. rev.: consumers, $4,000; city, $5,140. Hydrant rental, $55.71 for first 70, and $40 for each additional.

Management.—Prest., J. B. Gormly. Secy. and Treas., G. P. Smith, Bay City, Mich. Supt., D. C. Beall.

CANTON, *Stark Co.* (Pop., 12,258; est., 25,000.) On Nimishillen creek, on quite level ground. Manufactures agricultural implements, steel saws, safes, pocket cutlery, w. i. bridges, woolen goods, glass ware, pottery, watches. Settled in '06 Incorp. city. Has sewers and electric lights.

History.—Built in '69 by city. Engr., J. L. Pillsbury.

Water Supply.—Myers' lake, Nimishillen creek, and wells, by direct pumping. First supply was from lake, which is 2½ miles from city. This becoming inadequate, water was taken from creek, which is now the principal source of supply. In '89, 5 or more wells were drilled in sandstone to av. depth of 300 ft.

Lake has area of 150 acres, and drainage area of about 13 sq. m. Creek rises 5 miles above pumping station, and drains gravelly country.

Conduit.—Extends from lake to pumps, 1½ miles of 24-in earthenware pipe.

Pumping Machinery.—Dy. cap., 5,500,000 galls.; 2,000,000 and 3,000,000 comp., dup.; small Cameron pump has been used. Manufacturers report 5,000,000 Worthington, 2,000,000 Holly.

Distribution.—*Mains*, c. i., w. i., 30 miles. *Services*, galv. i. *Taps*, 1,700. *Meters*, 3. *Hydrants*, Holly, Mathews, Galvin, Ludlow, Bourbon, 232, including 13 private. *Pressure-recording gauge*, Edson.

Consumption, 1,100,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 100 lbs.

Financial.—Cost, about $300,000. Bonded debt, $140,000. Int., 5%. Ann. op. exp., about $8,000. Ann. rev., $16,000.

Management.—Three Trustees. Secy., P. Fields. Supt., L. B. Ohliger.

Reference.—"The Water Supply of Canton, O." By Josiah Hartzell. Read before O. Sanitary Assoc., at Canton, '89. Annals of Hygiene, Vol. IV., p. 58.

CHILLICOTHE, *Ross Co.* (Pop., 10,938; est., 12,000.) On Scioto river. Has various manufactories. No sewers. Has electric lights.

History.—Built in '81-2 by Chillicothe Gaslight & Water Co. Const. Engr., W. F. Inman. Contrs., R. D. Wood & Co., Philadelphia, Pa.

Water Supply.—Well on bank of Scioto river, pumping to reservoir.

Pumping Machinery.—Dy. cap., 3,500,000 galls.; 1,500,000 and 2,000,000 Worthington.

Reservoir.—Cap., 3,500,000 galls.

Distribution.—*Mains*, c. i., 22 miles. *Services*, galv. i., lead. Sub-contrs. for pipe and specials, Cincinnati & Newport Iron & Pipe Co. *Taps*, 800. *Meters*, Crown, Empire, Worthington, 20. *Hydrants*, Mathews, 115. *Valves*, Eddy.

Consumption, 700,000 galls. *Pressure*, 95 lbs.

Financial.—Cost, $250,000. Cap. stock, debt, int., withheld. Ann. op. exp., withheld, est., $4,000. Ann rev.: consumers, withheld, est., $18,000; city about $6,900. Hydrant rental, $60.

Management.—Prest. and Supt., F. S. Stacey. Secy., A. C. Kopp.

CINCINNATI, *Hamilton Co.* (Pop., 255,139; est., 275,000.) On north bank of Ohio river, covering about 24 sq. m. Plain 60 to 100 ft. above low water in river extends for some distance back from river, beyond which ground rises rapidly to elevation of 400 ft. Has large manufacturing and commercial interests. Founded in 1789; incorp. city in '19. Has sewers and electric lights.

History.—Built in '20 by Saml. W. Davis, who organized Cincinnati Water Co. in '26. Bought by city June 15, '39, and extended by it from time to time since. Suburban villages of Avondale and Clifton own 17 miles of pipe, and are supplied from Cincinnati. City controls their supply and collects all rev., and in 20 years, or earlier, is to own pipe in Avondale to amount of $75,000, and in Clifton to amount of $25,000, provided one-half of all revenues collected are refunded for the purpose.

When works were built in '20 the population was 9,642. Cap. stock of company a time of its organization was $75,000. When city purchased works there had been laid 22.3 miles of wooden logs, with a bore from 1½ to 2½ in., and nearly 4 miles of iron pipe, mostly 3 and 4 in., in diam. All mains laid since then have been of c. i.

Water Supply.—Ohio river, pumping to reservoirs for low and middle service and pumping to tank for high service. Drainage area above Cincinnati, about 77,000 sq. m., of which 8,000 sq. m. near city furnishes water containing salts of lime.

Hardness of supply varies with amount furnished by limestone basin. Supply is subject to contamination, water being taken from river about ¾ miles from center of city, and 5 miles from its upper limits. For a time the eddy from Deer creek canal caused much pollution, but this was temporarily stopped by sinking barges, and permanently by extending the intake pipes and changing the shore line.

Supply introduced by Saml W. Davis in '20 was pumped by horse-power from river to tank, and then repumped by horse-power to a wooden distributing reservoir.

Intake-Pipes and Aqueducts.—In '81 water was taken from river near channel, about 100 ft. from river front of pump-house, and conducted through iron pipes and stone aqueducts to pump-wells. In low water principal supply was furnished to pumps through two 40-in. pipes. These were laid on bed of river, extending 40 ft. from stone walls forming outer limits of aqueduct.

There are two aqueducts, one 5, and other 20 ft. wide. In large aqueduct a 60-in. w. i. pipe was laid for an independent supply to large engine, but owing to irregular operation, the pipe became packed with river deposit. Height of river varies 60 ft. and the suction pipes of pumps are placed below low water.

Pumping Machinery.—Dy. cap., 73,000,000 galls.; 31,500,000 of Worthington, most or all of remainder have been specially designed by Geo. Shield, T. R. Scowden, A. G. Moore, A. Worden. For description see MANUAL for '88, p. 304; also References, below.

General Description of Reservoirs.—First was of wood, built in '20. In '51, city built a low service reservoir, and '66, it began Eden Park middle service reservoir finishing upper basin in '75 and the lower in '78.

Low Service Reservoir.—Cap., 5,000,000 galls.; on Third street, 750 ft. from engine house and 165 ft. above it; rectangular, in two divisions, has dressed stone walls, and is entirely above surface of ground. Its flow-line is 170 ft. above low water in river; lowest point supplied is about 60, and highest 100 ft. above low water. In '81 about one-third of water consumed was supplied from this reservoir.

Eden Park Middle Service Reservoir.—Cap., 100,000,000 galls. In deep, rapidly descending ravine; is formed by retaining wall or dam, and divided by wall into upper basin of 57,000,000, and lower of basin of 43,000,000 galls. cap. Flow-line of this reservoir is 232 ft. above low water in river; lowest point supplied is 60, and highest 180 ft. above low water. Two 35-in. supply mains led from reservoir in '81, and high-service supply is repumped from here.

Dam is 119 ft. high, 48½ ft. wide at its base, 25.8 ft. at bottom of the reservoir, and 22 ft. at top; extreme length, 1,251 ft. Eight elliptical arches, 55 ft. long with 18-ft. rise, are constructed along outer face of dam to support part of a roadway. Arches, copings and pilasters are finished with dressed Dayton stone.

Southwestern part of lower basin is of filled ground, 85 ft. in depth. Division wall is 30 ft. wide at base, 10 at top, and 400 ft. long, including effluent and influent chambers, former being at west and latter at east end.

Effluent pipes: laid in tunnel, 12 x 1,100 ft., of four courses of brick in cement, costing $73,000. Reservoir cost $1,660,000.

High Service Tanks.—Cap., 1,400,000 galls.; two; each is 60 x 38 ft., of plates 50 x 144 ins., from 11-64 to 7-16-in. thick; vertical joints are double riveted, and bottom plates are ¼ in. thick. These receive water that is repumped from Eden Park reservoir for supplying higher districts. First tank was built in '69 on Mt. Auburn, and in '70 a second one was built for the same service.

In '81 another tank was completed on Price's Hill. It was 100 x 40 ft., placed on solid masonry foundation; steel, ½-in. thick at bottom, ¼-in. at top. When nearly full, for first time, tank gave way at bottom and was ruined. It is said that construction was not in accordance with specifications. It was designed by Jas. E. Bell, then Supt., and the Contrs. were Geo. Stacey & Co., Cincinnati. It is not stated whether this tank has been rebuilt.

Distribution.—*Mains*, c. i., 264 miles. *Services*, lead. *Taps*, 33,082. *Meters*, 1,304; first used in '60. *Hydrants*, made by city, number not given. *Valves*, made by city. *Pressure-recording gauge*, Edson. *Close of* '60: Mains, 83.66 miles. Taps, 12,600. Meters, 36. *Close of* '70: Mains, 133.08 miles. Taps, 18,629. Meters, 127. *Close of* '80: Mains, 188.86 miles. Taps, 23,627. Meters, 545.

Consumption, 32,271,426 galls. *Pressure:* extremely variable; not relied upon for fire protection.

Financial.—Cost, $7,847,495. Debt, $1,225,000. Int., 6, 7 and 7 3-10%. Ann. op. exp., $300.177. Ann. rev.: consumers, $662,092. Hydrant rental, in Avondale, $50 per mile. Cost, close of '60, $2,250,000; do., '70, $4,446,434; do., '80, $6,727,838. Rev., '60, $169,713; do., '70, $380,812; do., '80, $499,857.

Management.—Board of Public Affairs. Supt. and Engr., A. G. Moore.

References.—Tenth Census U. S., vol. XVII., Water Supply of Cities, pp. 101—111.

Also see references in MANUAL for '88.

CIRCLEVILLE, *Pickaway Co.* (Pop., 6,046; est., 10,000.) On Scioto river 25 miles from Columbus. River furnishes water-power used in manufacturing. City is on site of old circular fortification, hence its name. Incorp. Partially sewered. Has electric lights.

History.—Built in '86-7 by Circleville Water Supply Co., under 20-years franchise. Engr., E. F. Euller. Contr., Saml. R. Bullock. Both of N. Y. City.

Water Supply.—Darby creek, pumping from filter gallery on shore to standpipe.

Storage Reservoir.—Cap., 14,000,000 galls.

Filter Gallery.—No data.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two 1,500,000 Gaskill, comp., dup., cond.

Distribution.—*Mains*, 16 to 6-in. c. i., 12 miles. *Services*, w. i., lead. Pipe and specials from Dennis Long & Co., Louisville, Ky. *Taps*, 250. *Meters*, not given. *Hydrants*, Ludlow, 102. *Valves*, Ludlow.

Consumption, not given. *Pressure*, 70 to 100 lbs.

Financial.—Cost, $180,000. Cap. stock, $150,000. Bonded debt, $150,000. Int., 6%. Ann. op. exp., about $3,000. Ann. rev.: consumers, $4,100; city, $3,500. Hydrant rental, $35

Management.—Prest., C. C. Wolcot. Secy. and Treas., C. E. Kimball. Both of N. Y. City. Supt., W. E. Bolin.

CLEVELAND, *Cuyahoga Co.* (Pop., 160,146; est., 230,000.) On Lake Erie and both sides of the Cuyahoga river, the valley of which is but little above lake. On each side ground rises to elevation of 128 ft. Engaged in commerce, manufacturing and ship-building. Settled about 1796. Incorp. Has sewers and electric lights.

History.—Built in '54-'6 by city, when pop. was about 25,000. The building of the first system took from '53 to '58, a temporary intake being used meanwhile. From '69 to '74 important extensions were made, including a lake tunnel, and in '88 con-

tracts were let for a new and larger tunnel. Prior to '67 T. R. Scowden was Engr., and since then J. Whitelaw.

Cleveland Water Co. was organized in '33, had its privileges extended, and its cap. stock increased to $200,000 in '50, but never did any work.

Village of West Cleveland is supplied from these works through two meters being treated as a single customer. See West Cleveland.

Water Supply.—Lake Erie, pumping to reservoirs.

Old Intake: see MANUAL for '88, p. 306.

Intake Crib —Of 12-in. white pine, 61 ft. high, pentagonal, each outer side measuring 51, each inner, 19 ft. Midway between two walls is a second wall. Both sides of each wall are covered with 2-in. oak plank, the 3 walls are tied together and braced, and each wall has drift bolts running through the courses of timber. Spaces between middle, inner and outer walls are filled with stone to under side of floor or deck, which is 12 ft. above lake surface, except that for 5 ft. below low water space between middle and inner wall was filled with concrete, which serves as a foundation for a stone superstructure built on the crib in '78. About 400 cords of stone were placed around the crib. Before the crib was completed it had settled 14 ft. into clay, but has stood well since.

Water is admitted to well-hole of crib through two large openings near bottom of lake, each large enough to supply water to full cap. of the tunnel. From these openings gate wells extend to top of crib. For 5 ft. down from a little above high water outside of crib is plated on 3 exposed sides with ½-in. boiler iron, and on two shore sides with ¾-in. This was done to prevent thin ice from cutting timber, as during first winter grooves 1 in. deep were cut in this way. Contrs., D. D. & A. H. D. Delameter.

Tunnel.—Length, lake to shore shaft, following curves, 6,661.6 ft.; in straight line, 6,006 ft.; diam., 5 ft.

Extended in '75 from shore, 2,580 ft. to pump-wells, new part having diameters of 5½ and 6 ft.; bottom is 10 ins. lower than main tunnel at shore end, and 74 ft. below surface of old River St. Previous to this old aqueduct had been used.

Internal diam. of shafts, 8 ft.; depth below water surface, lake shaft, 90.2 ft., shore, 67½ ft. Inlet shaft from floor of crib to the top of tunnel is of iron, 46 ft. of lower portion being of 2-in. c. i., put together in 6 sections, each 7 ft. 8 ins. long. Four upper sections are of ¾-in. boiler iron, with c. i. flanges. All of sections are bolted together When water was admitted two of upper sections were removed, water flowing in over top, 9 ft. below surface, thus giving greater intake area than would have been secured by using gates at the sides. This tends to prevent the accumulation of anchor ice about the inlet.

Tunnel and extension driven through unstratified blue clay, some portions being dry and hard, others moist and soft. In this were stone varying in size from 4 cu. ft. to gravel. Distance from lake surface to rock under the clay is 80 ft. at the shore shaft, and 117 ft. at the crib. Rock is a soft, light-colored shale.

Contr., A. A. McDonnel; for extension, Jos. A. McDonnel, brother of former, they being associated in both jobs. Engr., Jno. Whitelaw; during early part of work T. R. Scowden was Consult. Engr.

For description of difficulties from soft clay, sand, gas, and water, and methods employed in overcoming same, see MANUAL for '88, p. 307.

New Tunnel.—From inlet crib to main pumping station, 7 ft. in diam., 9,200 ft. long; est. dy. cap., 110,000,000 galls., giving head of 13½ ft. on the suction pipes. Contract was let, Mar. 24, '88, to I. S. Casement, Painesville, O., for $201,301; will be finished in '90. Capacity of two tunnels will be 150,000,000 galls. For difficulties encountered in construction see Ann. Repts. of Trustees for '88 and '89; also *Eng. News.*, vol. xxii., pp. 433 and 505.

Foundations of Pumping Station.—On quicksand, there being two courses of 12-in. timbers, 1 ft. apart, with spaces filled with concrete. On this a flooring of large stones was laid, then inverted arches built to support walls of engine foundation and pump-well. Timbers extend beneath whole station, and under stand-pipe.

Pumping Machinery.—Dy. cap. 70,000,000 galls.; three 10,000,000 Worthington, 10,000,000 and two 15,000,000 Knowles; first four added, one each, in '74, '76, '82, '84, last two, '89. Henderson pumps in place, but little used in '88. First pumps, 7,500,000 Cornish, now used for high service; see MANUAL for '88, p. 308.

Stand-Pipe.—At engine house, 36 x 148 ft.

Force Mains.—First was 24 ins. in diam., 2,200 ft. long, leading to old reservoir. With new engines new mains were added, and for supply east of river there are now

one 16, one 20, two 30-in. mains, while a 30-in. main supplies part of city west of river, crossing being by 3 w. i. pipes, no 36, two 33 ins. in diam. All are ½-in. thick, double riveted, from 220 to 270 ft. long, dipping by easy curves 25 ft. below water surface and lying in trenches. Between two reservoirs, 30-in., 13,000 ft. long.

Old Reservoir.—Cap., 6,000,000 galls.; in embankment 21 ft. high, lined with 2 ft. of puddle, paved with brick in cem.

Fairmount Low Service Reservoir.—Cap., 80,000,000 galls.; two distinct basins conforming to topography, one holding 47,000,000, one 33,000,000 galls. Head of water is 170 ft. above Lake Erie. Land for this reservoir was bought in '82. Banks of loamy sand, on shale rock without heart-wall; 25 ft. high, 16 ft. wide, on top. Inner slopes, 1¾ to 1, with 10-in. sandstone paving on 6 ins. of broken stone; outer, 2 to 1, sodded. Bottom covered with 12 ins. concrete on 30 ins. puddled clay. *Discharge-pipes:* four; 30 and two 36-in. supply, 24-in. waste-pipe Does not leak. Built in '85-6. Engr., J. Whitelaw, Supt. Contrs., Wm. McReynolds and Jno. Gawne & Sons. Cost, $398,830.

High Service Reservoir.—Cap., about 38,000,000 galls.; area, 20 acres at base; depth, 20 ft.; is 325 ft. above Lake Erie, filled from Fairmount reservoir. Old Cornish engines were removed from main to high-service station. About a year after its completion water was drawn out to within 2 ft. of bottom. There was considerable ice in reservoir, and this together with drawing out of the water, caused banks and pavings to slide in, damaging a quarter of the paving, or less. Embankments were of clay, and it is claimed they had not fully settled.

Distribution.—*Mains*, c. i. 275¾ miles. *Services*, galv. i., lead. *Taps*, 27,516. *Meters*, 1,644. *Hydrants*, kind not given, 2,894. *Close of* '60: Mains, 25½ miles. Taps, 1,000. Meters, none. Hydrants, 138. *Close of* '70: Mains, 56¼ miles. Taps, 3,227. Meters, no record. Hydrants, 256 *Close of* '80: Mains, 115 miles. Taps, 11,561. Meters, 441. Hydrants, 998.

Consumption, 23,199,700 galls. *Pressure*, 12 to 70 lbs.

Financial.—Cost, $5,371,878. Debt, $1,775,000: $600,000 at 7, $975,000 at 6, $100,000 at 4, $100,000 at 3.65 %. Ann. op. exp., $96,047. Ann. rev.: $401,775. Cost, close of '60, $518,732; do., '70, $798,244; do., '80, $2,640,829. Rev., '60, $16,794; do., '70, $62,870; do., '80, $202,758.

Management.—Two Trustees. Secy., W. A. Madison. Supt. and Engr., Jno. Whitelaw.

References.—"The Water Supply of Cleveland." By Prof. Albert F. Smith, Cleveland. Read before 6th Ann. Meeting O. State Sanitary Assoc., 1889. The Annals of Hygiene, vol. IV., pp. 54-7.

Tenth Census U. S., vol. XVII., Water Supply of Cities, pp. 112-13.

Also see References in MANUAL for '88.

CLIFTON, *Hamilton Co.* (Pop., est., 1,200.) Suburb of Cincinnati: area, 1¾ sq. m.

General Description.—Supplied from Cincinnati water-works in '86. Village owns pipe, but contract with city provides for entire control of works and collection of revenue; pipe system to be owned by city after 20 years, or earlier, to amount of $25,000, provided one-half of all rev. collected by city be returned to village, semi-annually, for that purpose.

For further particulars address A. G. Moore, Supt. and Engr. Cincinnati water-works.

CLYDE *Sandusky Co.* (Pop., 2,380; est., 3,000.) Is 17 miles from Sandusky and 38 from Toledo. Has various manufactories. Incorp. No sewers or electric lights.

History.—Built in '83-4 by city. In '86 pipe system was extended and settling reservoir built. Engr., J. D. Cook, Toledo, O.

Water Supply.—Wells in settling reservoir, direct pumping; emergency supply from storage reservoir on Raccoon creek. Original supply from 3 flowing wells in bottom of settling reservoir. Oct., '88, well 13 ft. in diam., 30 ft. deep, was sunk in bottom of settling reservoir; 3 6-in. holes were drilled in bottom, through rock. Pumps now draw directly from this well.

Storage Reservoir.—Cap. not given; on creek, largely of natural formation.

Settling Basin.—Built in '86. Three flowing wells in bottom.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two 1,000,000-gall. Gordon & Maxwell, one a comp., cond., low-pressure, other a high-pressure.

Distribution.—*Mains*, c. i., 4½ miles. *Services*, galv. i. *Taps*, 191. *Meters*, none. *Hydrants*, Bailey, 38. *Valves*, Eddy.

Consumption 50,000 galls. *Pressure:* Ordinary, 25 lbs. Fire, 100 lbs.

Financial.—Original cost, $25,000; cost to date, not determined. Bonded debt, $26,000. Int., 6%. Ann. op exp., $1,688. Ann. rev., $1,309.

Management.—Prest., F. H. Harvey. Secy., O. W. Harrison. Treas., E. D. Harkness.

COLUMBUS, *Franklin Co.* (Pop., 51,647; est., 108,000.) On Scioto river, close by great iron and coal fields of State. Site nearly level. Has extensive trade and manufactories. Settled in '12. Incorp. Has sewers and electric lights.

History.—Built in '70 by city when pop. was 31,274; previous supply from wells.

Water Supply.—Ground water from filter galleries near Olentangy and Scioto rivers, by direct pumping. In '89 contract for sinking well 31 ft. in diam., 55 ft. deep was awarded to Free & Meredith, Pittsburgh, Pa.; price, $16,220.

Filtering Basins and Galleries.—First supply was from well on bank of Olentangy river, tributary of Scioto. In 73-4 filtering basins were built close to Olentangy river, and conduit built between these and old well. Lower basin was excavated to 27 ft. below ground, or 13 below river surface; slopes, 1 to 1, protected by riprap; bottom area, of 14,994 sq. ft. Its supply was from ground water and upper basin; latter had surface area of 8,742 sq. ft., and was excavated 7 ft. below river.

On river side of upper basin, 7 ft. below surface, gallery 18 x 21 ins was built, emptying into lower basin. From it 14 smaller galleries extended under upper basin, bottom of which was covered with graduated gravel and sand, coarsest gravel being at bottom, with 7 ins of fine sand at top. A 12-in. pipe admitted water from river to this basin, covering sand with 2½ ft. of water at low stages of river. Filter was too small, receiving 1,000,000 galls., of which it filtered but one-half.

In '77-9 natural filter gallery was extended along river bank from pumps. Conduit is elliptical, 36 x 42 ins. of specially molded arch brick, each alternate course in lower half having openings to admit ground water, where conduit passes through good gravel. Conduit is generally 23 ft. below surface, or 10 ft. below low water in river. It was constructed in open cut, through strata of alluvial deposit, quicksand and gravel. It is 5,715 ft. long, passing beneath Olentangy river and terminating at bend in Scioto, where well with gates and inlet pipes allows water to be drawn from river, if necessary.

In '85 gallery was extended, or new one built; no official data.

Pumping Machinery.—Dy. cap., 33,000,000 galls.; Gaskill; last two pumps triple comp., added in '89. For description of earlier pumps, see MANUAL for '88.

Scioto River Crossing.—By 10-in. w. i. pipe, 425 ft. long, having ball and socket joints. In '73 an ice gorge broke pipe in middle section, and whole length was relaid in a trench 30 ins. deep, dredged in river bottom.

Distribution.—*Mains*, c. i., w. i., 90.1 miles. *Services*, galv. i. *Taps*, 6,050. *Meters*, 503. *Hydrants*, Holly, Mathews, 710. *Valves*, Holly, Eddy. *Pressure-recording gauge*, Edson. *Close of* '71: Mains, 6.2 miles. Taps, 42. Meters, none. Hydrants, 30. *Close of* '80: Mains, 39½ miles. Taps, 2,145. Meters, 534. Hydrants, 319.

Consumption, 6,183,708 galls. *Pressure:* Ordinary, 70 lbs. Fire, 120 lbs.

Financial.—Cost, $1,856,780. Debt, $894,908; $594,908 at 6, $300,000 at 4%. Ann. op. exp., $33,189. Ann. rev.: consumers, $128,518. Cost, close of '71, $189,655; do., '80, $700,359. Rev., '71, $201; do., '80, $48,228.

Management.—Three Trustees. Secy. and Treas., L. A. Filler. Supt., A. H. McAlpine.

CRESTLINE, *Crawford Co.* (Pop., 2,848; est., 3,000.) On rolling ground. Has railroad shops and manufactories. Settled in '50; incorp. city in '55. No sewers. Has electric lights.

History.—Built in '69-70 by city. Des. Engr., H. W. McDonnell. Const. Engr Geo. C. Morgan, Chicago, Ill. Work done by city.

Water Supply.—Springs, by gravity from collecting reservoir.

Reservoir.—Cap., about 1,500,000 galls.; earth and stone, 120 x 280 ft., x 5½ ft. deep; 127 ft. above city. Inner slope, 1½ to 1; onter, 2 to 1. *Discharge-pipe:* 10-in. Does not leak. Built in '71. Engr., Geo. C. Morgan, Chicago. No Contr. Cost, $7,000.

Distribution.—*Mains*, Wyckoff, 9 miles. *Services*, galv. i. *Taps*, 170. *Meters*, 1. *Hydrants*, Holly-Gaskill, 36 *Valves*, Eddy.

Consumption, 50,000 galls. *Pressure*, 52 lbs.

Financial.—Cost, $100,000. Debt, $15,000. Int., 5%. Ann. op. exp., $1,000. Ann. rev.: consumers, 2,200.

Managem nt. Three Trustees. Secy., Adam Hoffman. Supt., M. C. Archer.

CUYAHOGA FALLS, *Summit Co.* (Pop., 2,284; est., 2,500.) On Cuyahoga river. Has manufactories. Incorp. city.

General Description.—Fire protection secured by about one mile of pipe and 15 hydrants; pumps at three of the manufactories connect with river and mains.

NOTE.—In early part of '90 effort was being made to raise $15,000, by bonds, for more extended works.

DAYTON, *Montgomery Co.* (Pop., 38,678; est., 55,000.) At junction of Mad and Great Miami rivers, on level plain. Has large car works and other manufactories. Settled in 1796; incorp. city in '41. No sewers. Has electric lights.

History.—Built in '69-70 by city. Consult. Engr., Wm. C. Weir.

Water Supply.—From 30 8-in. tube wells, by direct pumping, water flowing to well near pump house. Av. depth of wells, 40 ft.; on both sides of Mad river, connected to 20-in. pipe crossing river. For description of original supply see MANUAL for '88, p. 310.

Pumping Machinery.—Dy. cap., 17,000,000 galls.; 4,000,000 and 3,000,000 Holly quadruplex, 10,000,000 Gaskill horizontal, added in '89.

At first there were two elliptical rotary 2,000,000 pumps and a 3,000,000 set of gang pumps. In '80 these were removed, and four piston pumps substituted, old engine being retained. In '73-4 a 4,000,000 pump was added, having four 18x30-in. steam cylinders, 12-in. pumps.

Distribution.—*Mains*, c. i., 50 miles. *Services*, lead. *Taps*, 2,005. *Meters*, 126. *Hydrants*, Holly, Cummings, 480. *Pressure-recording gauge*, Edson. *Close of '70:* Mains, 22 miles. Taps, 462. Meters, none. Hydrants, 198. *Close of '80:* Mains, 5 ½ miles. Taps, 1,211. Meters, 18. Hydrants, 286.

Consumption, 1,988,000 galls. *Pressure:* Ordinary, 50 lbs. Fire, 120 lbs.

Financial.—Cost, $1,064,469. Bonded debt, $647,000: $42,000 at 6, $50,000 at 4½, $555 at 4%. Ann. op. exp., $24,000. Ann. rev.: consumers, $32,629. Cost, close of '70, $324,450; do., '80, $705,918. Rev.: '70, $3,149; do., '80, $18,277.

Management.—Three Trustees. Prest., Wm. Hoffman. Secy., Chas. A. Herbig.

DEFIANCE, *Defiance Co.* (Pop., 5,907; est., 8,500.) At confluence of Maumee and Auglaize rivers. Engaged in trade and manufacturing. Incorp. Has sewers and electric lights.

History.—Built in '87-8 by Defiance Water Co., under 30-years franchise. Engr., Ellis Morrison. Contr., Saml. R. Bullock. Both of N. Y. City.

Water Supply.—Maumee river, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 5,000,000 galls.; two comp., cond., kind not given.

Stand-Pipe.—Cap., 398,000 galls.; 22 x 140 ft.

Distribution.—*Mains*, c. i., 13 miles, *Services*, w. i., lead. Pipe and specials from Dennis Long & Co., Louisville, Ky. *Taps*, 275. *Meters*, none. *Hydrants*, kind not given, 139.

Consumption, 225,000 galls. *Pressure*, not given.

Financial.—Cost, $175,000. Cap. stock, $200,000. Bonds, $200,000. Int., 6%. Ann. op. exp., withheld, est., $3,000. Ann. rev.: consumers, $3,000; city, $5,515. Hydrant rental, $40.

Management.—Prest., D. A. Proody, N. Y. City. Secy., E. Squire. Supt., S. M. Stevens.

DELAWARE, *Delaware Co.* (Pop., 6,895; est., 9,000.) On Olentangy river, 25 miles from Columbus. Manufactures woolen goods, agricultural implements, chairs, iron fences, carriages and cigars. Incorp. Has sewers and electric lights.

History.—Built in '88-9 by Delaware Water Co.; controlled by Moffett, Hodgkins & Clarke, Watertown, N. Y., Engrs. and Contrs.

Water Supply.—Wells and springs, pumping to stand-pipe and direct.

Pumping Machinery.—Dy. cap., 4,000,000 galls.

Stand-Pipe.—Cap., 235,000 galls.; 20 x 100 ft.

Distribution.—*Mains*, c. i., 18 miles. *Hydrants*, 206. Other data not determined.

Financial.—Cost, $200,000. Debt, $180,000. Int., 6%. Ann. op. exp. and rev., not determined. Hydrant rental, about $38.

Management.—Prest., J. F. Moffett. Supt. of Const., H. N. P. Dole.

DENNISON and URICHSVILLE, *Tuscarawas Co.* (Pop., Dennison 1,518; Urichsville, 2,700. Combined, est., 7,000.) In Mill township, on opposite sides of small creek. Incorp. No sewers. Has electric lights. Has railway car and machine shops.

History.—Built in '88 by Dennison Water Supply Co., under 15-years franchise. Engr., C. M. Bennett, Richmond, Ind. Contrs., McCormick & Moran, Pittsburgh, Pa. No other data given in time for insertion.

Water Supply.—Big Stillwater creek, through filter gallery to receiving well, thence by pumping to reservoir.

Filter Gallery and Receiving Well.—Gallery 190 ft. long, ending in well, 25 ft. in diam., 24 ft. deep.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two 1,500,000 Worthington.

Force Main.—C. i. 12-in., 2,800 ft. long.

Reservoir.—Cap., 3,000,000 galls.; sides lined with brick.

Distribution.—*Mains.* 14 to 6-in. c. i., 10¾ miles. *Services*, lead. *Taps*, number not given. *Meters*, Worthington, number not given. *Hydrants*, Ludlow, 103. *Valves*, Ludlow.

Consumption, 600,000 galls. *Pressure*, 80 lbs.

Financial.—Cost, $300,000. Cap. stock, $125,000. Bonded debt, $125,000. Int., 6%. Ann. op. exp., $1,500, Ann. rev.: consumers, $5,400; city, $3,700. Hydrant rental, $40.

Management.—Prest., C. S. Sims, 243 S. 3d St., Philadelphia, Pa. Supt., Chas. B. Street.

EAST LIVERPOOL, *Columbiana Co.* (Pop., 5,568; est., 7,500.) On Ohio river, 44 miles from Pittsburgh. Has extensive pottery manufactories. Settled about 1800; incorp. village in '34. Has sewers and electric lights.

History.—Built in '79 by village. Des. Engr., R. C. Phillips.

Water Supply.—Ohio river, pumping to reservoir, and direct if desired.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; two 10-in. Cope & Maxwell, plunger.

Reservoir.—Cap., 2,500,000 galls.; 266 ft. above city.

Distribution.—*Mains*, c. i., 16 miles. *Services*, lead. *Taps* (in '82), 700. *Meters*, kind not given, 12. *Hydrants*, kind not given, 75.

Consumption, 1,000,000 galls. *Pressure:* Ordinary 110 lbs. Fire 160 lbs.

Financial.—Cost, $51,000. Debt, $25,000. Ann. op. exp., $5,000. Ann. rev.: consumers, $15,000.

Management.—Secy., Kate G. Surls. Supt., P. Morley.

EAST PALESTINE, *Columbiana Co.* (Pop., 1,047; est., 2,000.) In coal district. Incorp. village. Has various manufactories. No sewers or electric lights.

History.—Built in '89-90 by village; accepted Mar. 17. Engr., J. B. Strawn, Salem. Contr., for all but reservoir, M. Philbin, Chicago.

Water Supply.—Four drilled wells, pumping through distribution to reservoir. Water in wells rises near surface.

Pumping Machinery.—Dy. cap., 750,000 galls.; Gordon dup., high-pressure. *Boiler:* steel, tubular, 4½ x 14 ft.; from Mansfield Foundry & Boiler Co.

Reservoir.—Cap., 300,000 galls.; 50 ft in diam., 21 ft. deep; lined with fire brick in cem. Has octagonal roof, ventilated. Contrs., Bopp & Renshaw, East Palestine.

Distribution.—*Mains*, 10 to 4-in. c. i., 3.74 miles; from Lake Shore Foundry, Cleveland. *Hydrants*, Bourbon, 36 *Valves*, Bourbon.

Pressure, 96 lbs.

Financial.—Cost, exclusive of real estate, $23,500. Bonded debt, $25,000. Int. 5%.

Management.—Three Trustees. Prest. D. W. Moore. Secy. and Supt., S. H. Maneval.

ELYRIA, *Lorain Co.* (Pop., 4,777; est., 5,500.) At junction of East and West. branches of Black river, 25 miles from Cleveland. Manufactures shears, screws and other goods. Incorp. Has sewers. No electric lights.

History.—Built in '79 by Elyria Gas & Water Co.

Water Supply.—Black river, pumping to tank.

Pumping Machinery.—Dy. cap., 2,500,000 galls.; Worthington. *Boilers:* steel.

Tank.—Cap., 135,000 galls.; 34x20 ft.

Distribution.—*Mains*, c. i., 11 miles. *Services*, galv. i., lead. *Taps*, 405 *Meters*, none. *Hydrants*, Mathews, 61. *Valves*, Ludlow.

Consumption, 600,000 galls. *Pressure:* Ordinary, 34 lbs. Fire, 100 lbs.

Financial.—Cost, $160,000. Cap. stock, $100,000. Bonded debt, $75,000. Int., 7%. Ann. op. exp., $3,881. Ann. rev.: consumers, $6,300; city, $5,350. Hydrant rental, $85.

Management.—Prest., Geo. H. Ely. Supt., Secy. and Treas., D. M. Clark.

FINDLAY, *Hancock Co.* (Pop., 4,633; est., 20,000.) On Blanchard's fork of Auglaize river, in natural gas fields. Manufactures glass, furniture and nails, and refines oil. Incorp. Partially sewered. Has electric lights.

History.—Built in '88-9 by city. Engr., Jno. W. Hill, Cincinnati. Contrs., Houston & Freeman; failed to complete work; Contr. for completion, E. Ryan, Springfield.

Water Supply.—Blanchard river, pumping direct.

Dam and Storage Reservoir.—Cap., 86,000,000 galls. Dam of masonry. Contrs., Freeman & Houston.

Filter Galleries.—Contrs., W. H. Campfield & Co.

Pumping Machinery.—Dy. cap., 5,000,000 galls.; two Gordon & Maxwell, comp. dup., direct-acting.

Distribution.—*Mains*, 20 to 4-in. c. i., 18 miles; from Addyston Pipe & Steel Co., Addyston. Trenching and pipe-laying done by Jas. J. Rumsey, Canton. *Taps* and *Meters*, not determined. *Hydrants*, Bourbon, 139. *Valves*, Eddy.

Financial.—Cost, $275,000. Bonded debt, $300,000. Int., 5%. Ann. op. exp. and rev., not determined.

Management.—Three Trustees. Prest., B. F. Kimmons. Secy., Wm. Edwards.

FOSTORIA, *Seneca Co.* (Pop., 3,569; est., 6,000.) Engaged in manufacturing. Incorp. city. No sewers. Has electric lights.

History.—Construction begun Jan. 12, to be finished Oct. 1, '90, by city. Engr. J. M. Howell, Chicago, Ill. Asst. Const. Engr., G. D. Hersey.

Water Supply.—Surface water, pumping from reservoirs to stand-pipe. Drainage area, 17 sq. m.

Reservoirs.—Cap., 125,000,000 galls.; 110,000,000 and 15,000,000. Contrs., Cook & Heaton, Junction City, Kan.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; Gordon; two 1,500,000 comp., dup., horizontal. *Boilers:* from Mansfield Machine Works.

Stand-Pipe.—Cap., 367,000 galls.; 25 x 100 ft.; on masonry tower 53 ft. high. Contrs., Porter, Jackson & Co., So. Chicago, Ill.

Distribution.—*Mains*, 14 to 4-in. c. i., 16 miles. Pipe from Lake Shore Foundry, Cleveland; specials from Rockwell Machine and Car Co., Sandusky, O.; trenching and pipe-laying done by J. J. Rumsey, Findlay. *Hydrants*, Mathews, 135. *Valves*, Rensselaer.

Pressure: Ordinary, 50 to 65 lbs. Fire, "all department can handle."

Financial.—Cost, total of contracts and amount paid for land, $169,000. Bonds, authorized, $20,000.

Management.—Three Trustees. Prest., O. T. Brown, A. Mennell, C. German. Report, Jan. 28, '90.

FRANKLIN, *Warren Co.* (Pop., 2,385; est., 3,500.) On Great Miami river, 16 miles north of Dayton. Manufactures paper and agricultural implements. Incorp. Partially sewered. Has electric lights.

History.—Built in '87-8 by town. Engr., Jno. W. Hill, Cincinnati. Contr. for masonry and buildings, J. D. Hendrickson, Franklin.

Water Supply.—Six 6-in. driven wells, 64 ft. deep, connected with 6, 8 and 12-in. pipe, by direct pumping.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; two 750,000 Holly comp., dup., direct-acting.

Distribution.—*Mains*, c. i., 5¾ miles. *Services*, lead. Pipe and specials from New Philadelphia Pipe Works; trenching and pipe-laying done by Snyder & Williams, Dayton. *Taps*, 186. *Meters*, 1. *Hydrants*, Mathews, 61. *Valves*, Eddy.

Consumption, not given. *Pressure:* Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—Cost, $43,000. Bonded debt, $15,000. Int., 5%. Ann. op. exp., $2,400. Ann. rev., $1,500.

Management.—Trustees. Prest., M. W. Earhart. Secy., R. B. Moodie. No. Supt.

FREMONT, *Sandusky Co.* (Pop. 8,446; est., 10,000.) On Sandusky river at head of navigation, 24 miles from Sandusky, and 30 miles from Toledo. Incorp. Has sewers and electric lights.

History.—Built in '82-3 by city. Engr., J. D. Cook, Toledo, O.

Water Supply.—Mainly from springs, pumping from storage reservoir to stand pipe.

Reservoir.—Cap., about 2,500,000 galls.; 100 x 200 ft., x 15 ft. deep; within city limits, near Sandusky river.

Pumping Machinery.—Dy. cap., 4,000,000 galls.; 3,000,000 Worthington, comp., cond.; 1,000,000 Knowles, high-pressure. *Boilers:* two tubular, steel, 5½ x 15 ft.

Stand-Pipe.—Cap., 357,000 galls.; Otis' steel, 25 x 100 ft.; on hill near center of distribution, ½ mile from pumps, 50 ft. above center of city.

Distribution.—*Mains*, c. i., 12 miles. *Services*, galv. i., lead. *Taps*, 413. *Meters*, 7. *Hydrants*, Mathews, Lowry, 110. *Valves*, Ludlow.

Consumption, 533,285 galls. *Pressure:* Ordinary, 48 lbs. Fire, 90 lbs.

Financial.—Cost $148,000. Debt, $136,000. Int., 5%. Sinking fund, $6,000. Ann. op. exp., $4,102. Ann. rev.: consumers, $6,686.

Management.—Trustees. Sec., J. Edwards Supt., C. F. Reiff.

GALION, *Crawford Co.* (Pop., 5,635; est., 7,000.) Engaged in manufacturing. Incorp. Partially sewered. Has electric lights.

History.—Built in '82-4 by Galion Water-Works Co., under 30-years franchise. No Des. Engr. Const. Engr., Saml. C. Starr. Jesse W. Starr, Philadelphia, says he was connected with building of these works.

Water Supply.—Wells, 30 ft. in diam. and 28 ft. deep, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 3,000,000.; two Deane *Boiler:* Root.

Stand-Pipe.—Is 6 x 140 ft.; from Tippett's Sons, Harrisburg, Pa.

Distribution.—(In '87.) *Mains*, c. i., 10 miles. *Services*, galv. i. *Taps*, 250. *Meters*, none. *Hydrants*, Chapman, 95.

Consumption (in '87), 350,000 galls. *Pressure:* Ordinary, 30 lbs. Fire. 80 lbs.

Financial.—In '87.) Cost, $100,000. Cap. stock, $100,000. Bonds, $70.000. Int., 6%. Ann. op. exp., $300,000. Ann. rev: consumers, $3,000; city, $5,000 Hydrant rental, $60, $50 and $35, according to number, not given.

Management.—Prest., J. H. Green. Secy. and Treas., O. L. Hays. No Supt.

GRANVILLE, *Licking Co.* (Pop., 1,127; est., 1,500.) Is 6 miles west of Newark, and 25 east of Columbus. Incorp. No sewers or electric lights.

History.—Built in '85 by town.

Water Supply.—Driven wells, pumping to tank.

Pumping Machinery.—Dy. cap., 180,000 galls.; Knowles, comp., dup. *Boilers:* 50-H. P., horizontal, tubular.

Tank.—Cap., 95,000 galls.; 20 x 30 ft.

Distribution.—*Mains*, c. i., w. i., 5½ miles. *Services*, galv. i., black i. *Taps*, 124. *Meters*, 1. *Hydrants*, Bourbon, 37. *Valves*, Bourbon.

Consumption, 25,000 galls. *Pressure*, 87 lbs.

Financial.—Cost, $18,000. Debt, $13,400. Int., 6%. Ann. op. exp., $531. Ann. rev.: consumers, $1,008.

Management.—Secy., G. S. Gilpatrick. Supt., Chas. Tight.

HAMILTON, *Butler Co.* (Pop., 12,122; est., 17,000.) On Miami river, 20 miles from Cincinnati. Manufactures agricultural implements. Has electric lights.

History.—Built in '84 by city.

Water Supply.—Wagner steamed filter wells, pumping to reservoir and direct.

Pumping Machinery.—Dy. cap., 3,000,000 galls; Gordon & Maxwell.

Reservoir.—Cap., 6,703,885 galls.

Distribution.—*Mains*, c. i., 30 miles. *Services*, w. i., lead. *Taps*, 1,355. *Meters*, 75. *Hydrants*, Mathews, 215.

Consumption, 800,000 galls. *Pressure*, 95 lbs.

Financial.—Cost, $367,410. Debt, $365,000. Int., 5%. Ann. op. exp., $12,279. Ann. rev.: consumers, $15,544; city, $18,000. Hydrant rental, $75.

Management.—Three Trustees. Secy. and Supt., R. N. Andrews.

IRONTON, *Lawrence Co.* (Pop., 8,857; est., 12,000.) On Ohio river. Engaged in river commerce, iron and coal mining; has iron manufactories, nail mills, machine shops and tool works. Incorp. No sewers or electric lights.

History.—Built in '70-1 by city. Engrs. and Contrs., Coverdale & Weir. (Denison & Cowell, Muscatine, Ia., also reported as Contrs.)

Water Supply.—Ohio river, pumping to tank.

Pumping Machinery.—Dy. cap., 2,500,000 galls.; 2,000,000 Holly, 500,000 McGowan. *Boilers:* tubular.

Tank.—Cap., 160,000 galls.; 40 x 18 ft. Contrs., Lambert Bros.

Distribution.—*Mains*, c. i., 11 miles. *Services*, w. i., lead. Pipe and specials from Dennis Long & Co., Louisville, Ky., and Ohio Pipe Co., Columbus. *Taps*, 1,243. *Meters*, none. *Hydrants*, Chapman, Holly. 157. *Valves*, Chapman, Holly.

Consumption, 1,600,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 90 lbs.

Financial.—Cost, $185,000. Debt, $155.000: $18,000 at 8, $90,000 at 5, $47,000 at 4%. Ann. op. exp., $7,000. Ann. rev.: consumers, $18,000.

Management.—Three Trustees. Secy., Jos. Loyd. Supt., E. Lawton.

KENT, *Portage Co.* (Pop., 3,309; est., 4,000.) On Cuyahoga river, 10 miles N. E. of Akron. Has water-power, railway machine shops and manufactories. Incorp. No sewers. Has electric lights.

History.—Built in '86-7 by Kent Water Co., under 20-years franchise. Engr., Isaac S. Cassin, Philadelphia, Pa. Contrs., Holly Mfg. Co., Lockport, N. Y.

Water Supply.—Plum creek, pumping to stand-pipe and direct.

Storage and Subsiding Reservoir.—Cap., 10,000,000 galls.; on creek.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two 1,000,000 Gaskill dup. *Boilers:* two horizontal tubular, each 5 x 16 ft.

Stand-Pipe.—Cap., 115,000 galls.; 14 x 100 ft.; top, 200 ft. above pumping station.

Distribution.—*Mains*, c. i., 8½ miles. *Services*, w. i., lead. *Taps*, 239. *Meters*, none. *Hydrants*, Holly, 77. *Valves*, Holly.

Consumption, 207,000 galls. *Pressure:* Ordinary, 100 lbs. Fire, 150 lbs.

Financial,—Cost, withheld, est., $150,000. Cap. stock, $100,000. Bonded debt, $80,000. Int., 6%. Ann. op. exp., $2,900. Ann. rev.: consumers, $2,900; city, $3,750. Hydrant rental, $50,

Management—Prest., A. N. Martin. Secy., C. G. Hildreth, 45 Broadway, N. Y. City. Supt., A. B. Young.

KENTON. *Hardin Co.* (Pop., 3,940; est., 6,000.) On Scioto river, on rolling ground, in agricultural and lumber district. Settled in '20; incorp. in '33. Has sewers. No electric lights.

History.—Built in '81-2 by private Co., now owned by city. Contrs , Holly Mfg. Co., Lockport, N. Y.; Denison & Cowell, Muscatine, Ia.

Water Supply.—Well, by direct pumping. Well was sunk in limestone, 20 ft. in diam. and 24 ft. deep.

Pumping Machinery.—Dy. cap., 2,500,000 galls.; 1,500,000 Holly quadruplex, 1,000,900 Gaskill dup

Distribution.—*Mains*, c. i., 8 miles. *Services*, lead. *Taps*, 267. *Meters*, 2. *Hydrants*, kind not given, 71.

Consumption, 700,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 85 lbs.

Financial.—Cost, $94,000. Bonded debt, $80,000. Int., 6%. Sinking fund, about $4,000 Ann. op. exp., $3,500. Ann. rev.: consumers, $4,200.

Management.—Three Trustees. Prest., W. H. Young. Secy. and Supt., L. Fecker.

LANCASTER, *Fairfield Co.* (Pop., 6,803; est., 8,000.) On Hocking river, ground rising from river and Hocking canal to hill 263 ft. above canal. Settled in 1800 as New Lancaster, called Lancaster after '05. Has electric lights.

History.—Built in '80-2 by town; in '77 fire protection works were built, consisting of small pump and single line of pipe, taking water from Hocking canal. In '78 stand-pipe was added, and in '80-2 works extended for domestic supply. Contr. for masonry, Henry Kraus; for buildings, Jacob Schleckman. Both of Lancaster.

Water Supply.—Gallery and well, pumping to tank.

Gallery and Well.—Gallery in gravel, 4 ft. wide and 4½ ft. high, with brick side walls and arched top; takes water from bottom. At first it was 270 ft. long. Gallery connects with well 18 ft. in diam., 20 ft. deep. In '82 water rose to surface and wasted over top.

Pumping Machinery.—Dy. cap., 1,200,000 galls.; Worthington, 20 x 15-in. steam, 12-in. water cylinders. First pump was small and boiler inadequate. For a time steam was piped to engine from iron works. 200 ft. distant.

Stand-Pipe.—Cap., 133,000 galls.; 18 x 70 ft.; 133 ft. above water in suction pipe at well, 64 ft. above pump. Contrs., Matherwell Iron Works, Lancaster.

Distribution.—(In '87.) *Mains*, 12, 10 and 6-in. c. i., 8 miles. *Services*, lead. Pipe and specials from Cincinnati and Newport Iron Works; trenching and pipe-laying done by R. B. Carothers. All of Newport, Ky. *Taps*, 100. *Meters*, none. *Hydrants*, Chapman, 65.

Consumption (in '87), 200,000 galls. *Pressure*, 55 lbs.

Financial.—Cost (to Mar. 20, '82), $46,801. Debt, $25,000. Int., not given. Ann. op. exp. (in '87), $2,000. Ann. rev.: consumers (in '87), $3,000; city, none.

Management.—(In '88.) Three Trustees: J. B. Orman, Geo. Matt and Geo. Lutz. Report by former.

NOTE.—No reply to inquiries sent in '89.

LEETONIA, *Columbiana Co.* (Pop., 2,552; est., 3,500.) South side of village, level plateau; north, hilly. Engaged in coal mining, iron, boiler and tool manufacturing. Incorp. village. Has electric lights.

History.—Built in '89 by village. Engr., J. B. Strawn, Salem. Contrs., Chandler Bros. & Co, Beaver Falls, Pa.

Water Supply.—Spring, by gravity to collecting basin, thence by gravity to supply reservoir at pumps, thence by direct pumping, surplus going to small storage-reservoir. Spring walled with brick and covered with flag-stone.

Collecting Reservoir.—Cap., not given; vitrified brick, roofed and shingled.

Conduit.—To supply reservoir: 2,000 ft. 12-in. c. i.

Supply Reservoir.—Cap., not given. Same as receiving reservoir.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two Gordon, dup., comp. *Boilers:* two steel, tubular.

Storage Reservoir.—Cap., 500,000 galls.; circular, 19 ft. deep. Like other two.

Distribution.—*Mains*, 12 to 4-in. c. i., 6 miles. *Services*, lead. *Taps*, 130. *Hydrants*, Ludlow. *Valves*, Ludlow, 55. *Pressure-recording gauge*, Edson.

Pressure: Ordinary, 40 to 80 lbs. Fire, 120 lbs.

Financial.—Cost, $41,000. Bonds, $45,000. Int., 5%.

Management.—Three Trustees: J. F. Strausbaugh, Jno. O. Hoffert, Jno. Sculley. Report, Dec. 30, '89.

LIMA, *Allen Co.* (Pop., 7,567; est., 17,000.) On Ottawa River, in oil fields Has manufactories. Incorp. Has sewers and electric lights.

History.—Built in '85-7 by city. Engr., J. D. Cook, Toledo. Contr. for masonry and foundations, D. F. Minahan, Springfield; for buildings, Shaler & M——, Lima.

Water Supply.—Surface water, by gravity from impounding to storage reservoir, thence by direct pumping.

Reservoirs.—Cap., not given. *Impounding:* area, 6 acres; depth, 8½ ft. *Distributing:* area, 21 acres; depth, 18 ft.

Pumping Machinery.—Dy. cap., 6,000,000 galls.; two 3,000,000 Gaskill horizontal. *Boilers:* three Holly, 5¼ x 16 ft., with 55 4-in. tubes.

Distribution.—*Mains*, c. i., 20¼ miles. *Services*, galv. i. Pipe and specials from Cincinnati & Newport Iron Co., Newport, Ky. Trenching and pipe-laying done by H. N. P. Dole & Co., Columbus. *Taps*, 832. *Meters*, 6. *Hydrants*, Ludlow, Mathews, 154. *Pressure-recording gauge*, Edson.

Consumption, 414,198 galls. *Pressure:* Ordinary, 30 lbs. Fire, 75 lbs.

Financial.—Cost, $338,000. Bonded debt, $338,000. Int., 5%. Ann. op. exp., $5,169. Ann. rev.: consumers, $9,147.

Management.—Trustees. Prest., Wilbur Fisk. Secy. and Supt., D. E. Fritz.

LONDON, *Madison Co.* (Pop., 3,067; est., 5,000.) Has various manufactories. Incorp. village. Partially sewered. Electric lights contracted for.

History.—Construction began Dec. 20, '89, by The Jno. P. Martin Co.; to be in operation July 1, '90. Engr. and Contr., Jno. P. Martin, Xenia, O.

Water Supply.—Cook's wells, 6-in., pumping direct and to stand-pipe.

Pumping Machinery.—Dy. cap., 1,500,000 galls.

Stand-Pipe.—Cap., 293,000 galls.; 20 x 125 ft.

Distribution.—*Mains*, 14 to 4-in. c. i., 11 miles. *Hydrants*, 100.

Financial.—Cost, est., $110,000.

Management.—Address Jno. P. Martin, Xenia. Report, Jan. 13, '90.

LORAIN, *Lorain Co.* (Pop., 1,595; est., 3,500.) On Lake Erie at mouth of Black river, 28 miles from Cleveland by water. Manufactures brass goods. Incorp. No sewers or electric lights.

History.—Built in '84 by town. Contr. for all but buildings, M. Walker, Fenton, Mich.

Water Supply.—Lake Erie, by direct pumping.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; two Walker. *Boilers:* horizontal, tubular.

Distribution.—*Mains*, Wyckoff wood, 11.2 miles. *Services*, w. i., lead. *Taps*, 500. *Meters*, 1. *Hydrants*, kind not given, 45.

Consumption, 500,000 galls. *Pressure:* Ordinary, 55 lbs. Fire, 150 lbs.

Financial.—Cost, $47,000. Bonded debt, $50,000. Int., 6%. Ann. op. exp., $3,000. Ann. rev.: consumers, $4,500.

Management.—Three Trustees. Prest., C. H. Wamburton. Secy. and Supt., F. C. Norcross.

MANSFIELD, *Richland Co.* (Pop., 9,859; est., 15,000.) On Rocky Fork of Mohican river, elevated ground. Has manufactories. Settled in '14; incorp. city in '47. Has sewers and electric lights.

History.—Built in '70–2 by city. Engrs. and Contrs., Holly Mfg. Co., Lockport, N. Y.

Water Supply.—Five flowing artesian wells and two springs, by direct pumping.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; 2,500,000 Gordon & Maxwell added in '84. A 2,000,000 Holly formerly in use.

Distribution.—*Mains*, c. i., 23 miles. *Services*, w. i. *Taps*, 945. *Meters*, none. *Hydrants*, kind not given, 130.

Consumption, 1,250,000 galls. *Pressure:* Ordinary, 95 lbs. Fire, 95 to 120 lbs.

Financial.—Cost, $199,000. Debt, $27,000. Int., 6 and 8%. Ann. op. exp., $5,914. Ann. rev.: consumers, $10,000.

Management.—Three Trustees. Prest., A. C. Cummins. Secy. and Supt., Wm. Ritter.

MARIETTA, *Washington Co.* (Pop., 5,444; est., 8,000.) At junction of Ohio and Muskingum rivers, in coal-oil region. Engaged in manufacturing and commerce. Incorp. city. No sewers. Has electric lights.

History.—Construction begun Dec. 1, '89, by city; expected to be in operation July 1, '90 Engr., Jno. W. Hill, Cincinnati.

Water Supply.—Well near Ohio river, pumping direct and to stand-pipe.

Pumping Machinery.—Dy. cap., 1,250,000 galls.; Gordon; vertical comp., cond., dup. *Boilers:* Gordon.

Force Mains.—Diam., 12 ins.

Stand-Pipes.—Cap., 698,000 galls.; each 30 x 66 ft.; steel; from Riter & Conley, Pittsburgh, Pa.

Distribution.—*Mains*, 10 to 4 in. c. i., 12 miles; from Lake Shore Foundry, Cleveland; laid by R. Meredith, Marietta. *Hydrants*, 104. *Valves*, Rensselaer.

Pressure: Ordinary, 65 to 95 lbs.

Financial.—Cost, est., $85,000.

Management.—Chn., S. M. McMillan. City Clerk, Geo. Wieser. Latest report, Jan. 23, '90.

MARION, *Marion Co.* (Pop., 3,899; est., 9,000.) Engaged in manufacturing. Incorp. village. Plans for sewers made in '89. Has electric lights.

History.—Built in '89–90 by Scioto Water Co., under 25-years exclusive franchise. Engrs. and Contrs., Howland & Ellis, Boston, Mass. Engr.-in-charge, D. C. Henry, Marion.

Original franchise granted to Saml. R. Bullock, N. Y. City, and some preliminary work done. In '88 this franchise was repealed; new one granted to Howland & Ellis, who transferred it to Scioto Water Co.

Water Supply.—Water bearing gravel, 3 miles west of city, pumping to stand-pipe. Water is gathered and stored in reservoir.

Reservoir.— Cap., 15,000,000 galls.; water surface, 5 acres; min. depth, 10 ft.

Canal.—To pump-well; open, 800 ft. long.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two 1,500,000 Deane comp., dup., cond.

Force Main.—C. i., 16-in., 2½ miles long.

Stand-Pipe.—Cap., 330,480 galls.; iron, 25 x 90 ft.; solid stone foundation, 20 ft. high; 130 ft. above business part of town; from Tippett & Wood, Contrs., Phillipsburgh, N. J.

Distribution.—*Mains*, 16 to 4-in. c. i., 11½ miles; from Lake Shore Foundry. *Hydrants*, Cofiin, 113. *Valves*, Rensselear.

Pressure: Ordinary, 50 lbs. Fire, 100 lbs.

Financial.—Cost, est., $450,000. Cap. stock, $250,000 Bonds, $200,000. Int., 6%.

Management.—Prest., C. C. Reid, Delaware. Secy. and Treas., D. C. Henry.

NOTE.—Works finished early in '90. Date of report, Nov., '89.

MARTIN'S FERRY, *Belmont Co.* (Pop., 3,819; est., 6,000.) On Ohio river nearly opposite Wheeling, W. Va. Manufactures hardware, glass, iron, farming implements; has woolen and planing mills. Incorp. No sewers or electric lights.

History.—Built in '86-7 by city; water first supplied Dec. 15, '87. Engr., Geo. Hornung, Cincinnati.

Water Supply.—Ohio river, pumping through distribution to reservoir.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Gordon & Maxwell, vertical, dup. *Boiler*, tubular.

Reservoir.—Cap., 2,500,000 galls.; area, 0.9 acre; depth, 10 ft.; on side hill. Banks of clay, built up in layers, wet, rammed and rolled; no heartwall; 12 ft. high, 14 ft. wide on top. Inner slopes, 2 to 1, paved with 1 ft. of cut stone, laid dry on 18 ins. of puddle, puddle omitted on upper, or excavated, side. Paving surmounted by coping 1 ft. high, 2 ft. wide. Outer slopes, 1¾ to 1. Bottom covered with 4 ins. broken stone, on 8 ins. of puddle. *Influent and Effluent Chamber:* masonry with concrete bottom; about 5 ft. sq., 12 ft. deep; at foot of inner slope, top 2 ft. above bottom of reservoir. Water discharges over top of chamber. *Discharge-pipes:* two; 12-in. influent and effluent, 14-in. drain; slope of former, 7 to 1; latter, 36 to 1. Reservoir does not leak. Built in '87-8. Engr., see History. Contr., Jas. J. Rumsey, Canton. Cost, $17,472.

Distribution.—*Mains*, c. i., 7½ miles. *Services*, lead. Pipe and specials from Addyston Pipe & Steel Co., Newport, Ky; trenching and pipe laying done by J. J. Rumsey, Canton. *Taps*, 296. *Meters*, none *Hydrants*, Bourbon, 49. *Valves*, Ludlow.

Consumption, 120,000 galls. *Pressure*, 100 lbs.

Financial.—Cost, $114,000. Bonded debt, $120,000. Int., 5%. Ann. op. exp., $2,000. Ann. rev.: consumers, $1,200.

Management.—Three Trustees. Secy., J. S. Mitchell, Supt., C. S. Moore.

MASSILLON, *Stark Co.* (Pop., 6,836; est., 11,000.) On Ohio canal, in Tuscarawas coal fields. Manufactures cigars, glass, iron, engines and farming implements; has sandstone quarries within its limits. Incorp. Has sewers and electric lights.

OLD WORKS.

NOTE.—Built in '54, No further data.

PRESENT WORKS.

History.—Built in '85-6, and put in operation Feb., '87, by Massillon Water Co., under a 20-years charter. Chief and Des. Engr., C. Delafield. Const. Engr., Chester McFarland. Contr., Saml. R. Bullock's Co. All of N. Y. City.

Water Supply.—Sippo lake, filtered, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 4,000,000 galls.; two Blake comp., cond. *Boilers:* two 5 x 16-ft. tubular.

Filter.—Dy. cap., not given; National.

Stand-Pipe.—Cap., 550,000 galls.; 25x150 ft.; made by Tippett & Wood, Phillipsburgh, N. J.

Distribution.—(In '87.) *Mains*, c. i., 17 miles. *Services*, w. i., lead. Pipe and specials from McNeal Pipe and Foundry Co., Burlington, N. J. *Taps*, 586. *Meters*, 9. *Hydrants*, Ludlow, 160. *Valves*, Ludlow.

Consumption, not given. *Pressure:* Ordinary, 75 lbs. Fire, 150 lbs.

Financial.—(In '87.) Cost, $287,500. Cap. stock, $250,000. Bonded debt, $250,000, Int., 6%. Ann. op. exp., $4,200. Ann. rev.: consumers, $15,350; city, $6,600. Hydrant rental, $41.25.

Management.—Prest., Jno. G. Warwick. Secy. and Treas., R. B. Dodson, 2 Wall St., N. Y. City. Supt., W. A. Wade.

NOTE.—Later figures under Distribution and Financial refused.

MEDINA, *Medina Co.* (Pop., 1,484; est., 2,500.) In agricultural section.

General Description.—Built for fire protection by town, date not given. *Mains*, 8 and 10-in. *Hydrants*, Philadelphia.

MIDDLETOWN, *Butler Co.* (Pop., 4,538; est., 5,000.) On Miami river, on level ground, 37 miles from Cincinnati. Engaged in manufacturing. Settled in '15; incorp. village in '85. Has electric lights.

History.—Built in '73-4 by town, under direction of Trustees. Contrs., Holly Mfg. Co., Lockport, N. Y.

Water Supply.—Well, 23 ft. in diam., 33 ft. deep, by direct pumping.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; Smith & Vaile dup., erected '87. A 2,000,000 Holly quadruplex formerly used.

Distribution.—(In '87.) *Mains*, c. i., 12 miles. *Services*, lead. *Taps*, 500. *Meters*, 1. *Hydrants*, kind not given, 75.

Consumption, (in '87), 500,000 galls. *Pressure:* Ordinary, 43 lbs. Fire, 90 lbs.

Financial.—(In '87). Cost, $74,000. Bonded debt, $75.000. Int , 5%. Ann. op. exp. (in '85), $1,200. Ann. rev.: consumers, $4,500, city, none.

Management.—Three Trustees. Address L. Goff or Jas. D. Bonnell.

NOTE.—No reply to inquiries sent in '89.

MILAN, *Erie Co.* (Pop., 797; est., 1,500.) On Huron river, 8 miles from Lake Erie. Incorp. No sewers or electric lights.

History.—Built in fall of '88 by village. Engr., J. D. Cook, Toledo. Contr. for all labor, H. K. House, Norwalk. In Aug., '89, works not in use, having been locked up by Contrs. Council is divided over payment of debt of about $5,500, which trustees incurred above $10,000 originally voted.

Water Supply.—Ground water, gathered in infiltration reservoir, thence by gravity.

Reservoir.—Is 90x144 ft. x 20 ft. deep, with slopes 2 to 1.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Hughes. *Boiler:* from Hughes Mfg. Co., Cleveland.

Distribution.—*Mains*, 8 to 4-in. c. i., 2½ miles. *Services*, not given. Pipe and specials from Lake Shore Foundry, Cleveland. *Taps*, none. *Meters*, none. *Hydrants*, Mathews, 23. *Valves*, Eddy.

Consumption, none, at present. *Pressure:* Ordinary, 75 lbs. Fire, 150 lbs.

Financial.—Cost, $15,500. Bonded debt, $14,500; $5,500 at 6, $9,000 at 5%. Ann. op. exp. and rev., none, time of report.

Management.—(Aug. 5, '89.) No officers, old ones having resigned and new ones refusing to qualify. Report made by Darwin Fay, Ex-Clerk of Water-Wks. Bd.

MINERVA, *Stark Co.* (Pop., 565; est., 1,200.) Has car and machine shops glass and furniture factories. Incorp. Has sewers and electric lights

History.—Built in '86 by town. Des. Engrs., Fairbanks, Morse & Co., Chicago, Ill. Const. Engr., J. C. Harlow, Pittsburgh, Pa. Contrs., Pittsburgh (Pa.) Water & Gas Construction Co.. now Jas. H. Harlow & Co.

Water Supply.—Well, on bank of creek, pumping to tank. Pipe connects with creek for use in case of necessity.

Pumping Machinery.—Dy. cap., 240,000 galls.; Smith & Vaile. *Boiler:* vertical.

Distribution.—*Mains*, c. i., 2½ miles. *Services*, w. i. *Taps*, 70. *Meters*, 27. *Hydrants*, Mathews, 25.

Consumption, 27,000 galls. *Pressure*, 65 lbs.

Financial.—Cost, $13,600. Bonded debt, $12,000. Int., 5%. Ann. op. exp., $340. Ann. rev., $820.

Management.—Three Trustees. Prest., Wm. W. Hooper. Secy., S. Morehead. Supt., Jno. Young.

MOUNT GILEAD, *Warren Co.* (Pop., 1,216; est., 1,800.) On east branch of Olentangy river. No sewers or electric lights.

History.—Built in '87 by town. Contrs., Talmage Bros., Mt. Gilead.

Water Supply.—Two large springs, pumped ½ mile by two hydraulic rams; these furnish about 16 lbs. of water per hour. At night water is forced into public cisterns for fire protection. Water is raised 57 ft. from one spring, 72 ft. from other.

Distribution.—*Mains*, about 1½ miles. Six public watering places; also 5 cisterns.

Financial.—Cost, not given. Ann. op. exp., nominal. Rev., none.

Management—Street Comrs., Chf. Fire Dept., Mell B. Talmage.

MOUNT VERNON, *Knox Co.* (Pop., 5,249; est., 7,000.) On Kokosing river. Incorp. No sewers. Has electric lights.

History.—Built in '82 by town. Engr., Elias Ebert. Contrs. for masonry and foundations, Dougherty & Ferguson, Newark; for buildings, O. W. Hubble, Mt. Vernon.

Water Supply.—Surface and artesian well, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two Worthington comp. *Boilers:* tubular.

Stand-Pipe.—Cap., 205,000 galls.; 25 x 56 ft.; from Buckley Bridge & Boiler Works, Cleveland.

Distribution.—*Mains*, c. i., 13 miles. *Services*, w. i. Pipe and specials from Mellert Foundry & Machine Co , Reading, Pa.; trenching and pipe-laying done by Merigold & Co., Columbus. *Taps*, 615. *Meters*, none. *Hydrants*, Ludlow, 81. *Valves*, Ludlow.

Consumption, 315,000 galls. *Pressure:* Ordinary, 97 lbs. Fire, 125 lbs.

Financial.—Cost. $85,500. Bonded debt, $60,000. Int., 6%. Ann. op. exp. $3,500. Ann. rev.: consumers, $5,500.

Management.—Three Trustees. Secy., P. B. Chase. Supt., C. W. Koons.

NATIONAL MILITARY HOME, *Montgomery Co.* (Pop., not given.) Near Dayton.

History.—Built in '70 by U. S. Govt.; supplemental works built in '86. Contrs. Smith & Vaile Co., Dayton.

Water Supply.—At first, surface water, pumping to tank. In '86 six 6-in. tubular wells were sunk, 1½ miles east of the Home grounds, and water pumped from them through a 10-in. main to a reservoir on grounds, then repumped to tank.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; Smith & Vaile built in '86 and 88.

Reservoir.—No data.

Tank.—Cap., not given. Built by Brownell & Co., Dayton.

Distribution.—*Mains*, c. i., 3 miles. *Services*, c. i. Pipe and specials from Ohio Pipe Co., Columbus, O.; trenching and pipe-laying done by Snyder & Williams, Dayton. *Taps*, 75. *Meters*, none. *Hydrants*, kind not given, 22. *Valves*, Eddy.

Consumption, about 400,000 galls. *Pressure:* Ordinary, 65 lbs. Fire, 80 lbs.

Financial.—Cost. $37,500. No debt. Ann. op. exp., not given. No rev.

Management.—Board of Managers. Gov., J. B. Thomas.

NEWARK, *Licking Co.* (Pop., 9,600; est., 17,000.) On Licking river. Has railway repair shops, glass and stone works. Incorp. Has sewers and electric lights.

History.—Built in '85-6 by Moffett, Hodgkins & Clarke, Syracuse, N. Y., under 10-years franchise. Des. Engr., J. D. Cook, Toledo. Const. Engrs., Henry C. Hodgkins, Watertown, G. T. Keith, Olean, N. Y.

Water Supply.—Two surface wells in gravel, pumping to reservoir. First well was formed by sinking timber and masonry caisson, 30 ft. in diam., 24 ft. deep, water coming from gravel.

Pumping Machinery.—Dy. cap., 5,000,000 galls.; two 2,500,000 Gordon & Maxwell dup., comp., cond. *Boilers:* two 19-H. P., return tubular; from Watertown (N. Y.) Engine Co.

Reservoirs.—Cap., 3,000,000 galls.; 262 ft. above city; built under supervision of Wm. Craig.

Distribution.—*Mains*, c. i., 25 miles. *Service*, galv. i. Pipe and specials from Lake Shore Foundry, Cleveland, and Ohio Pipe Co., Columbus, one-half by each. *Taps*, 622. *Meters*, 18. *Hydrants*, Bourbon, 221. *Valves*, Bourbon.

Consumption, 589,900 galls. *Pressure*, 120 lbs.

Financial.—Cost, $300,000. Debt, $260,000. Int., 6%. Ann. op. exp., $6,000. Ann. rev.: consumers, $12,500; city, $9,825. Hydrant rental, $48 for 200, and $45 for additional.

Management.—Prest., John F. Moffett. Supt., Wm. A. Veach.

NEW LISBON, *Columbiana Co.* (Pop., 2,028; est., 3,200.) On Middle fork of Little Beaver river, on undulating ground. Has water-power used in woolen and other manufacturing; engaged in coal and iron industries. Settled in '02; incorp. in '25. Has sewers and electric lights.

History.—Built in '40; new works built in '88, by town.

Water Supply.—Four artesian wells, pumping to reservoir. First supply from springs, water being conducted through ½ mile of 4-in. wooden and iron pipe to reservoir 120 x 250 ft., formed by stone dam 20 ft. high and 120 ft. long, built across ravine, 80 ft. above center of town. Old system used in case of emergency.

Pumping Machinery.—Dy. cap., 300,000 galls.; Gordon & Maxwell, dup. *Boilers:* return, tubular, 4½ x 12 ft.

Reservoir.—Cap., 400,000 galls.; masonry. Contrs., New Lisbon Stone Co.

Distribution.—*Mains*, c. i., 4¾ miles. *Services*, w. i. Pipe and specials for new works from Addyston (O.,) Pipe & Steel Co.; trenching and pipe laying done by Robt. Rue, Minerva. *Taps*, 130. *Meters*, 1. *Hydrants*, Mathews and Ludlow, 38.

Consumption, 55,000 galls. *Pressure*, 47 to 115 lbs.

Financial.—Cost, $25,000. Bonded debt, $16,000. Ann. appropriation for sinking fund, $1,000. Int., 6%. Ann. op. exp., $1,300. Ann. rev.: consumers, $900.

Management.—Three Trustees. Secy., C. F. Briggs. Supt., W. A. Rankin.

NEW PHILADELPHIA, *Tuscarawas Co.* (Pop., 3,070; est., 5,000.) On Tuscarawas river. Engaged in mining salt, coal and iron, and in manufacturing woolen goods, sheet and muck iron, and farming implements. Incorp. No sewers. Has electric lights.

History.—Built in '86, under 15-years franchise, by New Philadelphia Water Co., which is controlled by American Water-Works & Guarantee Co., Ltd., Pittsburgh, Pa.

Water Supply.—Wells and Tuscarawas river, pumping to reservoir.

Pumping Machinery.—Dy. cap , 2,000,000 galls.; Blake.

Reservoir.—Cap., 2,500,000 galls.

Distribution.—*Mains*, c. i., 9 miles. *Services*, galv. i. *Taps*, 252. *Meters*, 10. *Hydrants*, kind not given, 86.

Consumption, 250,000 galls. *Pressure*, 110 lbs.

Financial.—Cost, not given, est., $100,000. Cap. stock, $100,000. Bonds, $65,000. Int., 6%. Ann. op. exp., withheld, est., $2,500. Ann. rev.: total, est., $8,000. Hydrant rental, $36.

Management.—Prest., O. P. Taylor. Secy., S. M. Highlands, Pittsburgh, Pa. Treas., W. S. Kuhn, Pittsburgh, Pa. Supt., D. B. Ludwick.

NORWALK, *Huron Co.* (Pop., 5,704: est., 7,500.) Engaged in manufacturing. Has electric lights.

History.—Built in '71-2 by town and reconstructed in '78 with J. D. Cook, Toledo, as Engr. No Engr. employed for first works, aside from Contrs., Holly Mfg. Co., Lockport, N. Y.

Water Supply.—Peru branch of Huron river, by direct pumping.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two Worthington placed in '77; one comp., with 14 x 24-in., one high-pressure, with 12 x 15-in. water cylinders. *Boilers:* two, 5 x 16 ft. Original pumps, 2,000,000 Holly.

Dam and Reservoir.—Cap., not given. Dam across stream, 1¾ miles from center of town and 58 ft. below it, forms reservoir. New stone dam was built in '80.

Filter.—Proved ineffective. Was of gravel; water passed into and through it horizontally; area was too small.

Flume.—From reservoir to pump-well.

Pump-Well.—Is 23 ft. in diam. and 24 ft. deep; water stands about 16 ft. deep.

Distribution.—*Mains*, c. i., 14 miles. *Services*, w. i. *Taps*, 400. *Meters*, none. *Hydrants*, Holly, 111.

Consumption, 900,000 galls. *Pressure:* Ordinary, 45 lbs. Fire, 85 lbs.

Financial.—Cost, $140,000. Debt, $15,000. Int., 4%. Ann. op. exp., $5,000. Ann. rev.: consumers, $5,500.

Management.—Three Trustees. Prest., N. H. Pebbles. Secy. and Supt , O. A. White.

OBERLIN, *Lorain Co.* (Pop., 3,242; est., 5,000.) Is 8 miles from Elyria. Incorp. No sewers. Has electric lights.

History.—Built in '87 by town; put in operation Dec. 23. Engrs., Dunham & Paine, Cleveland. Contrs. for masonry and buildings, Doerzbach & Duker, Oberlin.

Water Supply.—Springs, by direct pumping.

Storage Reservoir.—Cap., 5,000,000 galls.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two 1,000,000 Deane; one dup. comp., one high-pressure. *Boilers:* two horizontal tubular, 4½ x 15 ft.

Distribution.—*Mains*, c. i., 7 miles. *Services*, galv. i. Pipe and specials from Buffalo Cast Iron Pipe Co., Buffalo, N. Y.; trenching and pipe laying done by Philip Sullivan, Fremont. *Taps*, 85. *Meters*, 5. *Hydrants*, Mathews, 60. *Valves*, made by Lorain Mfg. Co.

Consumption, unknown.

Financial.—Cost, $51,000. Debt, $50,000. Int., 4½%. Ann. op. exp., $1,500. Ann. rev.: consumers, $700.

Management.—Three Trustees. Prest., E. Regal. Secy. and Supt., G. C. Prince

OHIO PENITENTIARY, *Columbus, Franklin Co.* (Pop., 1,600.) Has sewers and electric lights.

History.—Built in '85 by State. Engr., Geo. H. Rowland, Supt.

Water Supply.—Ohio river, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; Gordon. *Boilers:* from Capitol City Boiler Works, Columbus.

Stand Pipe.—Cap., 108,000 galls.; 12x108 ft.; from Matherwell Iron and Steel Works, Logan.

Distribution.—*Mains*, 8-in. c. i., 1 mile; from Columbus Pipe Works. *Taps*, 45. *Meters*, none. *Hydrants*, 11. *Valves*, Eddy.

Consumption, 1,000,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 120 lbs.

Financial.—Cost, $15,000.

Management.—Supt., Geo. H. Rowland. Report March 10, '90.

PAINESVILLE, *Lake Co.* (Pop., 3,841; est., 5,000.) On Grand river, 3 miles from Lake Erie and 29 from Cleveland. Engaged in manufacturing and trade. Has electric lights.

History.—Built in '82 by Painesville Water-Works Co. Engr. and Contr., B. F. Stephens, Flatbush N. Y.

Water Supply.—Wells and springs, pumping to stand-pipe and direct. Change of supply was contemplated in '89.

Storage Reservoir.—No data.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two 1,000,000. Worthington. *Boilers*: tubular.

Stand-Pipe.—Cap., 165,000 galls.; 20 x 72 ft.

Distribution.—*Mains*, c. i., 8 miles. *Services*, galv. i. *Taps*, 350. *Meters*, none. *Hydrants*, Mathews, 50. *Valves*, Chapman.

Consumption, 300,000 galls. *Pressure*: Ordinary, 50 lbs. Fire, 85 lbs.

Financial.—(In '87.) Cost, withheld, est., $115,000. Cap. stock, $150,000. Bonds, $120,000. Int., not given. Ann. op. exp., $3,500. Ann. rev., consumers, $3,000; city, $4,500. Hydrant rental, $90 for first 50, $50 for each additional.

Management.—Prest., C. A. Avery. Gen. Mgr., B. F. Stephens, Flatbush, N. Y. Treas., W. W. Wickes. Secy., C. D. Adams. Engr., A. O. Peebles.

PIQUA, *Miami Co.* (Pop., 6,031; est., 12,000.) On Miami river, 28 miles from Dayton. Has manufactories. Settled about 1800. Has electric lights.

History.—Built in '75 by city.

Water Supply.—Surface water, by direct pumping. Water is taken from hydraulic canal fed from Lewiston reservoir at headwaters of Great Miami river.

Pumping Machinery.—Dy. cap., 3,500,000 galls.; Flanders, dup., 2,000,000 Gordon & Maxwell, dup., both driven by water-power; latter added in '87.

Distribution.—*Mains*, c. i., 14 miles. *Services*, galv. i. *Taps*, 820. *Meters*, none. *Hydrants*, Mathews, 141. *Valves*, Eddy.

Consumption, 2,000,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 90 lbs.

Financial.—Cost, $280,000. Debt, $290,000. Int., 6 and 8%. Ann. op. exp., $2,400. Ann. rev.: consumers, $7,200.

Management.—Three Trustees. Secy., J. C. Smiley. Supt., L. Kiefer.

PORTSMOUTH, *Scioto Co.* (Pop., 11,321; est., 2 .000.) At junction of Scioto and Ohio rivers, on nearly level plateau extending back about a mile from river to range of hills. Engaged in manufacturing. Settled in 1798; incorp. town in '15. Has electric lights

History.—Built in '71 by city. Des. Engr., W. C. Weir. Contrs., Denison & Cowell, Muscatine, Iowa.

Water Supply.—Ohio river, by direct pumping.

Intake.—Brick and wood conduit, 210 ft. long.

Pumping Machinery.—(In '82.) Dy. cap., 2,000,000 galls.; six 14-in. Holly piston pumps, 14-in. stroke.

Distribution.—(In '87.) *Mains*, 16 to 4-in. c. i., 20 miles. *Services*, w. i. *Taps*, about 1,300. *Hydrants*, 100.

Consumption, about 2,000,000 galls. *Pressure:* Ordinary, 45 lbs. Fire, about 100 lbs.

Financial.—(For '82.) Cost, $200,000. Bonded debt, $150,000. Int., 8%. Ann. op. exp., $11,596. Ann. rev.: consumers, $13,881.

Management.—City Clerk, S. G. McCulloch. Supt., Thos. Watkins.

NOTE.—No reply to inquiries sent in '89.

RAVENNA, *Portage Co.* (Pop., 3,255; est., 4,000.) Manufactures glass and carriages. Incorp. Partially sewered. Has electric lights.

History.—Built in '85 by town. Engr., J. D. Cook. Toledo.

Water Supply.—Crystal Lake, by direct pumping.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two Knowles. *Boilers:* tubular, steel.

Distribution.—*Mains*, c. i., 13 miles. *Services*, galv. i., lead. *Taps*, 655. *Meters*, none. *Hydrants*, Ludlow, 96. *Valves*, Ludlow.

Consumption, 200,000 galls. *Pressure*, 50 lbs.

Financial.—Cost, $90,000. Debt, $90,000: $15,000 at 6, $75,000 at 5%. Ann. op. exp., $2,700. Ann. rev.: consumers, $6,000; city, none.

Management —Three Trustees. Secy., Wm. Grinnell. Supt., W. H. Linton.

SALEM, *Columbiana Co.* (Pop., 4,041; est., 6,000.) Manufactures lumber, machinery, stoves and pumps. Incorp. No sewers. Has electric lights.

OLD WORKS.

General Description.—Built in '62 by A. Phillips, pumping water from spring to tank. Pump was single-acting, 6½x 12-in. plunger. Tank had cap. of 39,000 galls., wood, on brick tower, 45 ft. above pump. In '81 artesian well was sunk, and in '82 Worthington pump of 5¾-in. water, and 6-in. steam cylinder was added. In '81 these works were owned by E. W. Silver, and consisted of 4 miles of 5 and 3-in. c. i. pipe, and 275 taps. Town had formerly paid $500 a year for hydrants, but was then taking water for fire protection from cisterns, paying $275 a year.

PRESENT WORKS.

History.—Built in '87 by Salem Water Co., under 20-years franchise. Des. Engr., B. R. Clarke, Boston, Mass. Const. Engr., H. F. Dunham, Cleveland. Contrs., Wisconsin Construction Co., Boston, Mass.

Water Supply.—Artesian wells and surface springs, pumping from collecting reservoir to stand-pipe

Reservoir.—Cap., 600,000 galls.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two 1,500,000 Blake dup., comp., cond. *Boilers:* two 80-H. P., return, tubular

Stand-Pipe.—Cap., 312,000 galls.; 25 x 85 ft. Contrs., Tippett & Wood, Phillipsburgh, N. J.

Distribution.—*Mains*, c. i., 15 miles. *Services*, galv. i. Pipe from Addyston Pipe and Steel Co., specials by Builders' Iron Foundry, Providence, R. I. *Taps*, 811 *Meters*, 20. *Hydrants*, Coffin, 163. *Valves*, Coffin. *Pressure-recording gauge*, Edson.

Consumption, 200,000 galls. *Pressure:* Ordinary, 75 lbs. Fire, 125 lbs.

Financial.—Cost, withheld, est., $200,000. Cap. stock, $250,000. Debt, and int., withheld. Ann. op. exp., withheld, est., $5,000. Ann. rev.: total, withheld. est., $15,500. Hydrant rental, $25; hydrants placed 500 ft. apart.

Management.—Prest., B. S. Ambler. Treas., J. W. Brown. Supt., F. W. Allison.

SANDUSKY, *Erie Co.* (Pop., 15,838; est., 23,000.) On Sandusky bay, an inlet of Lake Erie, having a good harbor. City underlaid with limestone formation, which comes to surface in many places. Has large lumber, lime, stone, iron, fruit, wine and fish industries. Incorp. Has sewers and electric lights.

History.—Built in '75-6 by city. Engr., J. D. Cook, Toledo.

Water Supply.—Sandusky bay, pumping to stand-pipe. Water taken from cove in bay, which is shut off from contamination with impurities discharged by Sandusky river.

Intake Crib.—Octagonal; inner diam., 25, outer, 45 ft.; two double rows of timber walls, 8 ft. apart, filled between with broken sandstone. It extends from rock bottom to 6 ft. above ordinary water level.

Intake Conduit.—From crib to pump-well, 1,800 ft. long. First 1,387 ft., 36-in. w. i., remaining 413 ft., 36-in. brick conduit. Pipe is laid in a trench prepared by dredging and submarine blasting. It was floated and lowered to place by scows and chains. A flanged half-sleeve was riveted on ends of each section, the two bolted together, then cemented. Crib end of pipe has vertical elbow, at upper end of which is perforated copper plate screen. In Feb., '80, copper screen was found to be covered with tough, fibrous, fungous growth, which when dried was non-combustible and resembled moss. Intake pipe becoming empty rose from its anchorage and separated at joint near coffer dam.

Pump-Well.—In solid rock, 8 x 22 ft., 21½ ft. below engine house floor; lined with brick.

Pumping Machinery.—Dy. cap., 10,500,000 galls. Worthington; 3,000,000 and 7,500,000 dup., comp., cond., latter added in '88-9. Two 2,000,000 Worthington non-cond. formerly in use.

Stand-Pipe.—Double, outer pipe being 25x180 ft., with storage cap. above 160 ft. of 276,000 galls. Inside of this is a pipe 3 x 225 ft. for fire protection. Each pipe is built of steel plates, those in the outer one running from ⅜-ins. thick at bottom to 3-16 ins. at top. Bottom course is leaded into c. i. shoes, constructed in segments with flanges and bolts, and forming when in place a perfect circle. It rests in a groove cut in the solid rock. Riveted to second course of pipe are twelve 1¼-in. iron rods passing 8 ft. into the rock, and secured by lead and wedges. There is an iron staircase on lake side of pipe.

Oct. 20, '78, inner pipe burst 100 ft. below top, falling against the top of outer pipe and injuring a section 25 ft. long. After repairs inner pipe was of ¼-in. plates for 140 ft., 3-16 for 60, ⅛ in. for 25 ft.

Distribution.—*Mains*, 20 to 3-in. c. i., 26½ miles. *Services*, c. i., w. i., lead. *Taps*, 1,692. *Meters*, Crown, Empire, Worthington, Union, Hersey, 63. *Hydrants*, Lowry, Mathews, 179. *Valves*, Ludlow, Whittier, Klotz & Kromer. *Pressure-recording gauge*, Edson.

Consumption, 2,089,630 galls. *Pressure:* Ordinary, 35 to 70 lbs. Fire, 95 lbs.

Financial.—Cost, $433,432. Debt, $379,000. Int., 5 and 7%. Sinking fund, $150,000. Ann. op. exp., $12,172. Ann. rev.: consumers, $18,426. Op. exp. '80, $8,213. Rev., '80, $11,129. Total op. exp., Sept., '76, to Dec. 31, '88, $127,103. Do., rev., $165,559.

Management.—Three Trustees. Secy., Wm. Affleck. Supt., Chas. A. Judson.

Reference.—Tenth Census U. S., Vol. XVII., Water Supply of Cities, pp. 58–62.

SIDNEY, *Shelby Co.* (Pop., 3,823; est., 6,000.) On Great Miami river, on level plateau surrounded by hills. Engaged in manufacturing. Settled in '20; incorp. city in '50. Has electric lights.

OLD WORKS.

General Description.—Built in '73 by city. Engr., T. R. Scowden. Small stone dam across Yawawa creek diverted water to raceway two miles long, which conveyed it to point where head of 29 ft. furnished power to drive 800,000-gall. Holly pumps, water being delivered directly to mains. Dam formed reservoir of 7½ acres, having av. depth of 15 ft., 50 below highest part of city. To close of '81 these works had cost $54,000, including distribution system, which is used for new works, being somewhat remodeled and extended. Op. exp. in '81 were $300, in addition to which city paid rental of $800. Rev. was $560. There were at that time 5 miles of mains, 40 hydrants, 150 taps.

NEW WORKS.

History.—In '88 new works were designed by Geo. Hornung, Cincinnati, distribution system of old works being only part retained.

Water Supply.—Great Miami river and wells, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 2,500,000 galls.; 1,000,000 and 1,500,000 Gordon. A 2,000,000 Holly formerly used. *Boilers:* two, tubular, 5 x 16 ft., from Gordon Steam Pump Co.

Filter.—Cap., 500,000 galls.; American.

Stand-Pipe.—Cap., 212,000 galls.; 25 x 85 ft.; Contrs., Porter Mfg. Co., Syracuse, N. Y.

Distribution.—(Includes old and new.) *Mains*, c. i., 7 miles. *Services*, lead. Specials for the old works from from J. Wagner. Pipe and specials for new works from Addysten (O.) Pipe & Steel Co.; trenching and pipe-laying done by Keating & Houston. *Taps*, 165. *Meters*, none. *Hydrants*, kind not given, 55. *Valves*, new, Bourbon.

Consumption, 9,000 galls.; *Pressure:* (Old works.) Ordinary, 50 lbs. Fire, 100 lbs.

Financial.—Cost, about $110,000. Bonded debt, $66,000, of which $16,000 is on old works. Int., old rate, 6%. Ann. op. exp., $300. Ann. rev.: consumers, $750.

Management.—(For '88.) Three Trustees. City Engr., W. A. Ginn. Supt., Jacob Wagner.

NOTE.—Above subject to corrections, as no answers have been made to inquiries since shortly after letting of contracts for new works.

SPRINGFIELD, *Clarke Co.* (Pop., 20,730; est., 35,000.) On Logonda creek, on gently undulating ground. Manufactures agricultural implements, machinery, iron, turbine water wheels, coffins, engines and windmills. Settled in '04; incorp. village in '27; city afterwards. Has sewers and electric lights.

History.—Built in '81-2 by city. Engr., J. D. Cook, Toledo.

Water Supply.—Springs in gravel, pumping from collecting reservoir to standpipe.

Reservoir.—Cap., not given; in excavation, 140 x 290 ft. on top, 15 ft. deep; slopes, 3 to 1. *Discharge-pipe*: 20-in. Built in '87. Engr., see History. Contr., Ed. Ryan, Springfield. Cost, about $4,000.

Old Filter.—Filter gallery was first built along bank of Buck creek, and two wells dug 100 ft. apart, connected by dry stone culvert, 3 ft. in diam.

New Filter.—Built in '88; unofficially reported as 900 ft. long, 4 x 5 ft. in cross-section, wood, with spaces for water to enter from gravel formation. Surrounded by broken stone and gravel, 25 ft. below bottom of wells.

Pumping Machinery.—Dy. cap., 8,000,000 galls.; 3,000,000 Gordon, comp.. cond.; 5,000,000 Gaskill horizontal added in '89. *Boilers:* tubular.

Stand-Pipe.—Cap., 592,000 galls.; 30 x 112 ft.; 220 ft. above center of city.

Distribution.—*Mains*, c. i, 33½ miles. *Services*, lead. Pipe and specials from Warren Foundry & Machine Co., Phillipsburgh, N. J.; trenching and pipe-laying done by Eugene Buckley, Cincinnati. *Taps*, 1,856. *Meters*, 60. *Hydrants*, Eddy, Chapman, Ludlow, Mathews, Whittier, 295. *Valves*, kind, do.

Consumption, 2,000,000 galls. *Pressure*, 80 lbs.

Financial.—Cost, $419,621. Debt, $410,000. Int. 5%. Ann. op. exp., $16,600. Ann. rev.: consumers, $24,361; city pays interest on bonds, $20,000, raising money by taxation.

Management.—Three Trustees. Prest., E. C. Gown. Secy. and Supt., W. R. Smith.

STEUBENVILLE, *Jefferson Co.* (Pop., 12,033; est., 14,000.) On right bank of Ohio river, on high ground. Low water in river is 640½ ft. above sea. Manufactures iron, nails, glassware, china and crockery, machinery, stoves, boilers and woollen goods. Natural gas is used quite generally in city. Settled in 1797; incorp. city in '51; extended in '71. Has electric lights.

History.—Supplied prior to '35 from springs through wooden pipes. In '35, town built works, and in '67 extended them.

Water Supply.—Ohio river, pumping to reservoir. Supply taken below point where city drainage discharges.

Intake Pipe.—Two 15-in. pipes are laid on bed of river for 300 ft. and connect with pump-well.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; two 150-H. P. engines, with plunger pumps built by Jas. Means & Co., in '67. Pump erected in '35 was a 40-H. P. steam pump, and forced water ¾ miles through 8-in. pipe to a reservoir 192 ft. above river.

Force Main.—Diam., 20 ins.

Reservoirs.—Cap., 2,000,000 galls. In '35 a 400,000-gall., and in '67 a 600,000-gall. reservoir was built. It is not stated whether these are still in use, and no description of an additional reservoir is given.

Distribution.—(For '87.) *Mains*, 4 to 20-in. c. i., 30 miles. *Services*, lead. *Taps* (in '82), 1,725. *Meters*, none. *Hydrants*, Means & Irwin, 140.

Consumption, 1,000,000 galls. *Pressure:* Ordinary, 65 lbs.

Financial.—(In '87.) Cost, said to be unknown, est., $400,000. No debt. Ann. op. exp., $7,500. Ann. rev.: consumers (in '81), $16,750; city, $22,000.

Management.—(In '88.) Three Trustees. Secy., R. E. Blinn. Supt., Wm. Hunt.

NOTE.—No reply to inquiries sent in '89.

TIFFIN, *Seneca Co.* (Pop., 7,879; est., 10,000.) On both sides of Sandusky river, on level ground, in Clinton township. Engaged in manufacturing. Settled in '10; incorp. city in '50. Has sewers and electric lights.

History.—Built in '78-9 by Tiffin Water-Works Co., under 25-years franchise. Des. Engr., S. L. Wiley, Omaha, Neb. Const. Engr., E. C. Cook. Contrs., Wiley Construction Co.

Water Supply.—Sandusky river, by direct pumping.

Dam and Canal.—Dam built to furnish water-power for pumping; 230 ft. long. Canal conveys water to pumps.

Reservoir.—Small; near canal, from which it is filled by 12-in. pipe; 12-in. pipe leads to pump-well, and waste-pipe discharges to river.

Pumping Machinery.—Dy. cap., 7,000,000 galls.; 2,500,000 Holly quadruplex, 3,000,000 Gaskill horiz., cond., 1,500,000 Knowles, direct-acting. *Boilers:* two tubular.

River Crossings.—Pumps being on north side of city, one mile above its center, river is crossed at pump-house by 16-in. main, and near center of city by 12-in.; 16-in. main is laid down south, and 10-in. main down north, shore.

Distribution.—*Mains*, c. i., w. i., 15 miles. *Services*, w. i. *Taps*, 750. *Meters*, 30. *Hydrants*, Mathews, 114. *Valves*, Eddy, Chapman.

Consumption, 650,000 galls. *Pressure*, 110 lbs.

Financial.—Cost, to '84, $175,000. Debt. and int., not given, Ann. op. exp., withheld, est., $5,000. Ann. rev.: total, withheld, est., $18,000. Hydrant rental, av., about $75.

Management.—Prest. and Mgr., M. Scannell.

TOLEDO, *Lucas Co.* (Pop., 50,137; est., 80,000.) On both sides of Maumee river, 5 miles from Maumee bay, 8 from Lake Erie. Ground rises gradually from the river to level upon which most of residences are built. Has harbor and is engaged in shipping and manufacturing. Settled in '32; incorp. city in '36. Has sewers and electric lights.

History.—Built in '73-4 by city. Engr., J. D. Cook, Toledo.

Water Supply.—Maumee river, filtered, pumping to stand-pipe.

Intake Crib.—Irregular hexagon, with two sides 80 ft. long and parallel to current of river, and other four sides each 37½ ft. long. Formed by two rows of ground piles driven close together, with space between filled on outside with broken stone, on inside with gravel.

Intake Conduit.—From crib to filter basin. Brick, 5 ft. in diam., 500 ft. long, built in open trench on land, by means of a coffer-dam in water.

Filter Basin.—Area, 19,000 sq. ft; slopes, 1½ to 1, finished with puddle wall, paved with sandstone. Bottom of concrete, and from bottom up filtering material consists of 24 ins. of broken stone, 6 ins. each of 2, 1, ½ and ¼-in. gravel, and 24 ins. of fine sand.

Max. depth of water is 4 ft., and it passes to clear water basin through gathering drains and effluent pipe, thence to pump-wells.

In '75 filter bed filled so rapidly with silt that it was almost useless, and since then it has been inadequate.

Pumping Machinery.—Dy. cap., 15,000,000 galls.; two 5,000,000 Worthington, 5,000,000 Knowles. *Boilers:* return, tubular.

Stand-Pipe.—Of No. 1 charcoal iron, ½-in. thick, 5 x 224 ft.; 260 ft. above river, 240 above pumps; enclosed in an ornamental masonry tower.

Submerged Pipe.—On line to E Toledo, 1,600 ft. 16-in., laid beneath Maumee river in '88.

Distribution.—*Mains*, c. i., 63 miles. *Services*, lead. *Taps*, 3,210. *Meters*, 349. *Hydrants*, mostly Mathews, 435. *Valves*, "all kinds." *Close of '80:* Mains. 46.8 miles. Taps, 1,732. Meters, "no record." Hydrants, 349.

Consumption, 4,774,829 galls. *Pressure:* Ordinary, 50 lbs. Fire, 98 lbs.

Financial.—Cost, about $1,250,000. Debt, $1,000,000. Int., 8%. Ann. op. exp., $21,683. Ann. rev.: consumers, $65,398; city, by taxation, $80,000. Total disbursements to Jan. 1, '89, $1,145,477. Rev., consumers, '80, $26,123. Total rev., to close of '88, $517,889.

Management.—Three Trustees. Prest., M. T. Huntley. Secy., D. Segur. Supt., H. Cotter.

Reference.—Tenth Census U. S., vol. XVII., Water Supply of Cities, pp. 62-5.

TROY, *Miami Co.* (Pop., 3,803; est., 5,000.) On Miami river. Engaged in manufacturing. Incorp. No sewers. Has electric lights.

History.—Built in '86 by town. Des. Engr., J. D. Cook, Toledo. Const. Engr., Harry Evans, Troy. Contrs., M. Philbin & Co., Chicago.

Water Supply.—Well, 25 ft. in diam., 20 ft. deep, 9 ft. being through gravel. In May, '89, supply from well had begun to diminish.

Reservoir.—Area, 40 acres; used only to store water for power.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; Smith & Valle, water-power. New pump projected in '89.

Distribution.—*Mains*, c. i., 8½ miles. *Services*, w. i., lead. Pipe and specials from Ohio Pipe Co., Columbus. *Taps*, 380. *Meters*, none. *Hydrants*, Mathews, 84. *Valves*, Eddy.

Consumption, 24,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 70 to 90 lbs.

Financial.—Cost, $80,000. Debt, $80,000. Int., 6%. An. op. exp., $1,300. Ann. rev.: consumers, $2,100.

Management.—Three Trustees. Prest., N. Toby. Secy. and Supt., I. N. Brice.

UPPER SANDUSKY, *Wyandot Co.* (Pop., 3,540; est., 4,500.) On Sandusky river. Has foundries, machine and carriage shops. Incorp. city of second class. Has sewers and electric lights.

History.—Built in '89-90 by Upper Sandusky Water Co., under 20-years franchise; put in operation April 1. Engr., W. W. Taylor. Contrs., W. W. Taylor and W. S. Coon, Upper Sandusky.

Water Supply.—Springs, pumping from two collecting wells to stand-pipe and direct. Wells are 100 ft. in diam.

Pumping Machinery.—Dy. cap., not given; Blake.

Stand-Pipe.—Cap., 200,000 galls.

Distribution.—*Mains*, 12 to 4-in., 12½ miles. *Hydrants*, Taylor, 100. *Valves*, Bourbon. *Pressure:* Ordinary, 60 lbs. Fire, 150 lbs.

Financial.—Cost, $100,000. Cap. stock and debt, withheld. Int., 6%. Hydrant rental, $40.

Management.—Prest., N. McConnell. Secy. and Treas., E. A. Coon. Supt. W. S. Coon. Report, March 4, '90.

URBANA, *Champaign Co.* (Pop., 6,252; est., 8,000.) In rolling country, on nearly level ground, having gravel subsoil from 10 to 30 ft. below surface. Small spring-fed stream flows through town. Settled in 1792; incorp. city in '67. No sewers. Has electric lights.

History.—Built in '78 by Urbana Water-Works Co., under 10-years franchise. Contrs., Holly Mfg. Co., Lockport, N. Y.

Water Supply.—Well, 20 ft. in diam.. 15 ft. deep, by direct pumping.

Pumping Machinery.—Dy. cap., 3,500,000 galls.; 1,500,000 Holly quadruplex, 2,000,000 Gaskill horizontal, latter added in '89.

Distribution.—*Mains*, c. i., 14 miles. *Services*, lead. *Taps*, 660. *Meters*, 1. *Hydrants*, Mathews, 110. *Valves*, Ludlow.

Consumption, 700,000 galls. *Pressure:* Ordinary, 40 lbs.

Financial.—Cost, $125,000. Cap. stock, $40,000. Bonded debt, $100,000. Int., 6%. Ann. op. exp., withheld. Ann. rev.: consumers, $4,000; city, $6,000. Hydrant rental, $55.

Management.—Prest., A. F. Vance. Secy. and Supt., F. W. Ambrose.

URICHSVILLE, *Tuscarawas Co.* See Dennison and Urichsville.

WADSWORTH, *Medina Co.* (Pop., 1,219; est., 3,000.) Is 13 miles from Akron, 35 from Cleveland. Engaged in coal mining. Incorp. No sewers or electric lights.

History.—Built in '80 for domestic supply by Wadsworth Water-Works Co., under 10-years franchise; now owned by R. F. Weaver, who completed works.

Water Supply.—Four flowing springs, by gravity; springs about 1¼ miles from, 80 ft. above, business part of town; excavated 20 x 30 ft., x 8 ft. deep, lined with heavy oak timbers.

Distribution.—*Mains*, Wyckoff wood, iron, 6¼ miles. *Services*, galv. i. and lead. *Taps*, 800. *Meters*, 4. *Hydrants*, none.

Consumption, unknown. *Pressure*, 75 lbs.

Financial.—Cost, $15,000. No debt. Ann. op. exp. (in '87), $200. Ann. rev.: consumers (in '87), $1,200; city, none.

Management.—Owner and Mgr., R. F. Weaver.

WARREN, *Trumbull Co.* (Pop., 4,428; est., 7,000.) On Mahoning river, in coal and iron region. Incorp. Has sewers. No electric lights.

History.—Built in '86-7 by Saml. R. Bullock & Co., under a 20-years franchise. Engr., Ellis Morrison. Both of N. Y. City.

Water Supply.—Mahoning river, pumping from filter gallery to stand-pipe.

Filter Gallery.—No data.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two Deane, comp., cond.

Stand-Pipe.—Cap., 393,000 galls.; 22x140 ft.

Distribution.—*Mains*, c. i., 12 miles. *Services*, w. i. lead. Pipe and specials from R. D. Wood & Co., Philadelphia, Pa. *Taps*, 309. *Meters*, 5. *Hydrants*, Bailey, 102. *Valves*, Eddy.

Consumption, 225,000 galls. *Pressure:* Ordinary, 75 lbs. Fire, 150 lbs.

Financial.—Cost (in '87), $180,000. Cap. stock, $150,000. Bonded debt, $150,000. Int., 6%. Ann. op. exp., $3,500. Ann. rev.: consumers, $7,500; city, $4,570. Hydrant rental, $45 for 100, $35 for additional.

Management.—Prest., C. C. Pomeroy, N. Y. City. Secy., C. E. Kimball, N. Y. Supt., Geo. H. Quimby.

WASHINGTON COURT HOUSE, *Fayette Co.* (Pop., 3,798; est., 6,000.) Has manufactories. Incorp. No sewers. Has electric lights.

History.–Built in '89 by Washington Water Co., under 20-years franchise, after expiration of which city has right to purchase. Engr. and Contr., Jno. P. Martin, Xenia.

Water Supply.—Battery of wells, pumping direct and to stand-pipe.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two Worthington comp., cond.

Stand-Pipe.—Cap., 294,000 galls.; 20x125 ft.; from Hawkins & Son, Springfield, Mass.

Distribution.—*Mains*, 16 to 6-in. c. i., 16 miles. *Services*, galv. i., lead. *Taps*, 450. *Hydrants*, 132.

Pressure: Ordinary, 40 to 50 lbs. Fire, 60 to 80 lbs.

Financial.—Cost, est., $140,000. Hydrant rental, $40.

Management.—Address Jno. P. Martin, Xenia. Latest report, Sept. 20, '89.

WAYNESBURGH, *Stark Co.* (Pop., 622; est., 700.) Has foundry and furniture factory.

General Description.—Small system, springs by gravity from receiving basin; ½ mile pipe. Address W. A. Robertson or W. Klotz.

WELLSVILLE, *Columbiana Co.* (Pop., 3,773; est., 5,000.) In Yellow creek township, on Ohio river, on bottom lands, surrounded by hills from 200 to 500 ft. above the river. Has manufactories. Settled in '23; incorp. in '29. Has electric lights.

History.—Built by city in '81. Des. Engrs., Edelburn & Cooper. Const. Engr., Jno. A. George. Contrs., Inman Bros., N. Y. City.

Water Supply.—Ohio river, pumping to reservoir.

Intake Crib.—Of 8 x 10-in. oak timbers, 12 x 16 ft., x 10 ft. deep, sunk in river 100 ft. from shore. In the bottom 11 4-in. c. i. pipes, 12 ft. long, were driven 10 ft. deep. These were perforated for 3 ft. from lower end, which is stopped by a wooden plug. Through these pipes water flows upward into crib.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; two Worthington dup., 18½ x 10-in. steam, 10¼-in. water cylinders.

Force Main.—C. i., 10-in.

Reservoir.—Cap., 2,500,000 galls.; in excavation; diam., 106 ft. at bottom, 182 ft. at flow line, 17½ ft. above; 334 ft. above pumps. Bottom covered with broken stone on 20 ins. of clay puddle; slopes lined with 4 ins. of brick on 15 ins. of puddle.

Distribution.—(In '87.) *Mains*, 8 to 4-in. c. i., 7 miles. *Services*, lead. *Taps* 600. *Meters*, 2. *Hydrants*, kind not given, 60.

Consumption (in '87), 300,000 galls. *Pressure:* Ordinary, 100 lbs. Fire, 150 lbs.

Financial.—(In '87.) Cost, $62,500. Debt, $60,000. Int., 5½%. Ann. op. exp., $3,800. Ann. rev.: consumers, $5,900; city, $3,300, being int. on bonds.

Management.—Three Trustees. Supt., A. S. Foge.

WEST CLEVELAND, *Cuyahoga Co.* (Pop., 1,781; est., 5,000.) Adjoins Cleveland. Incorp. No sewers or electric lights.

History.—Built in '78 by town.

Water Supply.—Cleveland water-works, through four 4-in. meters at line dividing two corporations.

Distribution.—*Mains*, kind not given, 4 miles. *Services*, not given. *Taps*, 170. *Meters*, 20. *Hydrants*, kind not given, 45.

Consumption, 44,957 galls. *Pressure*, not given.

Financial.—Cost, $19,000. Debt, $12,000. Int., 6%. Sinking fund, $1,300. Ann. op. exp., $200. Ann. rev.: consumers, $2,400.

Management.—Three Trustees. Secy., J. D. Senn.

WOOSTER, *Wayne Co.* (Pop., 5,840; est., 7,000.) In hilly country between Killbuck and Apple creek. Elevation of city varies 290 ft. Engaged in manufacturing. Settled in '09; incorp. village in '17; city in '69. Has sewers and electric lights.

History.—Built in '69 by town. Des. Engr., Emil Low. Rebuilt or extended in '76, Jno. Brinkerhoof, Des., and G. P. Low, Const. Engr.

Water Supply.—Springs and well, by gravity from former, by pumping from latter.

Dam.—Forms reservoir built in '69; of puddled earth, 300 ft. long x 20 ft. high.

Reservoirs.—Cap., 12,000,000 galls.; two of 6,000,000 galls. each, receiving and distributing spring and surface water. First one covers about 1½ acres, has an average depth of 10 ft. and is 130 ft. above lowest part of city. One was built by city, other by P. Reddick.

Pumping Machinery.—Dy. cap., 500,000 galls.; Worthington. *Boiler:* Barrett, tubular.

Distribution.—*Mains*, 12 to 4-in. c. i., 11 miles. *Services*, ¾-in. galv. i. Pipe and specials from Dennis Long & Co., Louisville, Ky.; laid by T. B. Keating, Mansfield. *Taps*, 290. *Meters*, Crown, 6. *Hydrants*, Mathews, 103. *Valves*, Eddy.

Consumption, 150,000 galls. *Pressure*, 55 lbs.

Financial.—Cost, $115,000. Debt, $15,000. Int., 6 and 8%. Ann. op. exp., $1,200. Ann. rev.: consumers, $3,000; city, none.

Management.—Three Trustees. Secy., W. Moirett. Supt., Z. Potter.

XENIA, *Greene Co.* (Pop., 7,026; est., 10,000.) Manufactures lumber, glass, oil, twine, pumps and carriages; has granite and marble works. Incorp. No sewers or electric lights.

History.—Built in '87 by Xenia Water-Works Co., under 20-years franchise. Des. Engr., Jno. P. Martin, Xenia. Const. Engr., Chas. L. Goodhue. Contrs., Goodhue & Birnie, Springfield, Mass.

Water Supply.—Springs, pumping direct and to stand-pipe.

Dam and Reservoir.—Cap., 3,000,000 galls.; area, about 1 acre; depth, 10 to 2 ft. Dam of gravel, with heart-wall; 425 ft. long, 19 ft. high, 12 ft. wide on top, 40 to 60 at bottom. Both slopes, 2 to 1, inner rip-rapped. *Heart-wall:* clay, with sheet-piling in center; trench 7 ft. wide, 6 ft. deep; first dug, then sheet-piling driven in center till top was about 8 ft. below water-line; trench then filled and heart-wall carried up from natural surface, 6 ft. thick. *Spillway:* about 20 ft. from end of dam, in earth, lined with plank; 15 ft. wide, 4 ft. deep, free; slope, 2 to 1. *Discharge-pipes:* two, 14 and 12-in.; slope, slight.

When first filled dam leaked somewhat; several loads of clay were thrown at foot of inner slope, and leak stopped. Engrs. and Contrs., Goodhue & Birnie, Springfield, Mass.

Pumping Machinery.—Dy. cap., 3,500,000 galls.; two Gordon & Maxwell, comp., dup. *Boilers:* two tubular.

Stand-Pipe.—Cap., 281,000 galls.; 20 x 115 ft.; from R. F. Hawkins, Springfield, Mass.

Distribution.—*Mains*, 14 to 6-in. c. i., 19 miles. *Services*, galv. i., lead. Pipe and specials from Addyston Pipe & Steel Co.; trenching and pipe-laying done by R. B. Caruthers, Newport, Ky. *Taps*, 400. *Meters*, National, 5. *Hydrants*, Chapman, 180. *Valves*, Chapman.

Consumption, 300,000 galls. *Pressure*, Ordinary, 80 lbs. Fire, 150 lbs.

Financial.—Cost, $205,000. Cap. stock, $200,000. Bonded debt, $200,000. Int., 6%. Ann. op. exp., $3,000. Ann. rev.: consumers, withheld, est., $9,500; city, $7,500. Hydrant rental, $37.50 for first 200.

Management.—Prest., John Little. Secy. and Supt., Geo. F. Cooper.

YOUNGSTOWN, *Mahoning Co.* (Pop., 15,425; est., 30,000.) On both sides of Mahoning river, on hilly ground rising abruptly on north, and more gradually on south side to 175 ft. above river. Engaged in iron manufacturing and coal mining. Incorp. village in '48 and city in '67. Has sewers and electric lights.

History.—Built in '72 by city. Contrs., Holly Mfg. Co., Lockport, N. Y.

Water Supply.—Mahoning river, by direct pumping.

New Conduit.—Built in '88 from new pump well to river; brick, 50 ins. in diam., 154 ft. long, 26 ft. below surface. It connects with old pump-well, there being chamber at intersection containing two 36-in. gates.

New Pump-Well.—Is 26 ft. deep, 10 ft. inside diam., with brick top 10 ft. high, covered with slate.

Foundation of new pump.—Of solid brick and Wampum cem., with pit in center, 6 x 25 ft., x 10 ft. deep, in which is the Vacuum pump.

Pumping Machinery.—Dy. cap., 8,000,000 galls.; 3,000,000 Worthington dup. 5,000,000 Deane, latter added in '87, to supplement 2,000,000 Holly piston and rotary pumps. *Boilers:* three horizontal, one upright, tubular.

Distribution.—*Mains*, c. i., 25 miles. *Services*, lead. *Taps*, 1,522. *Meters*, 90. *Hydrants*, Mathews, 195. *Valves*, Ludlow, Galvin. *Pressure-recording gauge* Edson.

Consumption, 1,717,274 galls. *Pressure:* Ordinary, 85 lbs. Fire, 100 lbs.

Financial.—Cost, $261,890. Debt, $125,000: $15,000 at 6, $110,000 at 5%. Sinking fund, $5,000. Ann. op. exp., $12,000. Ann. rev.: consumers, $29,630.

Management.—Three Trustees. Secy., D. N. Simpkins. Supt., W. S. Hamilton.

ZANESVILLE, *Muskingum Co.* (Pop., 18,133; est., 27,000.) On both sides of Muskingum river, a navigable stream, mainly on level land surrounded by hills. In bituminous coal region; is engaged in manufacturing. Settled about 1800. Incorp. city in '55. Has sewers and electric lights.

History.—Built in '42 by town. Engr., Elias Elbert.

Water Supply.—Muskingum river, pumping to reservoirs.

Pumping Machinery.—Dy. cap., 8,000,000 galls.; 2,000,000 and 3,000,000 Worthington added in '68 to supplement double-acting piston pumps put in when works were built. *Boilers:* Zanesville.

Reservoirs.—Cap., not given; two, 186 x 100 ft., x 17 ft. deep, and 180 x 200 ft., x 15 ft. deep, respectively. Of brick and stone, 185 ft. above river.

Distribution.—*Mains*, c. i., 44 miles. *Services*, w. i., lead. *Taps* (in '87), 3,219. *Meters*, 3. *Hydrants*, Zanesville, 225.

Consumption, 2,831,900 galls. *Pressure*, 70 lbs.

Financial.—Cost (in '87). $517,473. Debt, $310,000. Int., av., 4.23%. Ann. op. exp., $19,016. Ann. rev.: consumers, $31,054

Management.—Three Directors. Secy., H. S. Crozier. Supt., R. M. Saup.

Water-Works Projected with Fair Prospects of Construction.

BOWLING GREEN, *Wood Co.* (Pop., 1,539; est., 4,000.) Is 19 miles from Toledo, in natural gas district. Engaged in wood-working and agriculture.

Proposed Works.—Sept., '89, Ira C. Taber stated that probably an effort to build works would be made in '90.

BRIDGEPORT, *Belmont Co.* (Pop., 2 395; est., 4,000.) On Ohio river, opposite Wheeling, W. Va. Has glass and nail factories.

Proposed Works.—City to obtain supply from Martin's Ferry water-works. Est. cost, $25 000. Address Geo. McKee or R. Howell.

CARTHAGE *Hamilton Co.* (Pop., est., 2,500.)

Proposed Works.—Village was to vote on question Apr. 11, '90. Supply, driven well, pumping to stand-pipe. Est. cost, $15,000 to $20,000. Clerk, E. E. Ross.

COSHOCTON, *Coshocton Co.* (Pop., 3,044; est., 4,000.) On Muskingum river. Engaged in manufacturing and coal mining. Has electric lights.

Proposed Works.—April 7, '90, Jno. W. Cassingham, Jas. B. Manner, E. M. Motley were elected trustees to build works.

GREENWICH, *Huron Co.* (Pop., 647; est., 1,500.) Manufactures agricultural implements.

Proposed Works.—April 12, '90, Jno. M. Marty stated that project was being pushed.

LEBANON, *Warren Co.* (Pop., 2,703; est., 4,000.) In iron and coal region. Has iron works and electric lights.

Proposed Works.—In Jan., '90, bid of Snyder & Williams, Dayton, was informally accepted by city, but no binding contract could be made till after popular vote at April elections. Supply, driven wells, pumping to stand-pipe. Est. cost, $45,000. City Clerk, M. E. Gustin.

LOCKLAND, *Hamilton Co.* (Pop., 1,884; est., 2,500.) Manufactures starch, paper and cotton goods.

Proposed Works.—Under consideration Jan. 24, '90. Previously Queen City Water Co. had submitted to city proposition to lay 5 miles of mains and place 45 hydrants for yearly rental of $1,800.

MARYSVILLE, *Union Co.* (Pop., 2,061; est., 3,000.) Has electric lights.

Proposed Works.—Jan. 25, '90. C. F. Lentz stated that project would be voted on in Apr. Supply, wells, pumping to stand-pipe. Co. to build.

TORONTO, *Jefferson Co.* (Pop., est., 3,000.) On Ohio river. Manufactures fire-brick sewer pipe and terra cotta for building purposes.

Proposed Works.—Bids were received in Jan. for works to be built by city. Jan. 6, it was expected that construction would begin Jan. 20, and works be completed by July 1. Engr., J. D. Cook, Toledo. Supply, Ohio river, pumping to reservoir. Est. cost, $50,000. Secy., O. Y. Crawford. See *Eng. News*, vol. XXIII., p. 120, for list of bids.

VAN WERT, *Van Wert Co.* (Pop. 4,709; est., 6,000.) Has electric lights.

Proposed Works.—Jan. 2, '90, Water Board just organized. City to build. Supply, wells. Est. cost, $75,000. Feb. 7, '90, bids were received for sinking 5 6-in. wells, not over 225 ft. deep. Mayor, J. O. Browder. Clerk, W. B. Jones. Contracts for works, proper (probably), will be let June 1, '90.

Water-Works Projects Reported in '89 and '90, but now Indefinite.

Greenville, Darke Co. *Hillsborough*, Highland Co. *Madisonville*, Hamilton Co. *Miamisburgh*, Montgomery Co. *Milford*, Clermont Co. *Napoleon*, Henry Co. *Pomeroy*, Meigs Co.; see MANUAL for '88, p. 327. *Wilmington*, Clinton Co.

INDIANA.

Water-Works Completed or in Process of Construction.

ANDERSON, *Madison Co.* (Pop., 4,126; est., 6,000.) Engaged in manufacturing and trade. Incorp. No sewers. Has electric lights.

History.—Built in '86 by town. Engr., J. D. Cook, Toledo, O. Extensions made in '87 with Snyder & Williams, Dayton, as Contrs.

Water Supply.—White river, by direct pumping; also well 25 ft. in diam. x 30 ft. deep.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; Gordon & Maxwell. *Boilers:* from Barney & Kilby, Sandusky.

Distribution.—*Mains*, c. i., 7 miles. *Services*, galv. i. Pipe and specials from Dennis Long & Co.; trenching and pipe-laying done by Geo. W. Clay, Toledo. *Taps*, 300. *Meters*, 1. *Hydrants*, Mathews, 70. *Valves*, Eddy.

Consumption, 450,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 80 lbs.

Financial.—Cost, $45,000. No debt. Int., 5%. Ann. op. exp., $1,800. Ann. rev.: consumers, about $2,100.

Management.—Three Trustees. Secy., E. B. McMahon. Supt., A. Coburn.

ATTICA, *Fountain Co.* (Pop., 2,150; est., 3,000.) On Wabash river, 22 miles from La Fayette. Has manufactories.

History.—Built in '73-4 by town. No Engr. Labor done by local parties.

Water Supply.—Springs, pumping to reservoir.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; two Deane.

Reservoir.—Is 20 x 40 ft., 300 ft. above pumps.

Distribution.—(In '87.) *Mains*, c. i., 10 miles. *Services*, iron. *Taps*, 265. *Meters*, none. *Hydrants*, kind not given, 20.

Consumption (in '87), 9,000 galls. *Pressure*, 45 lbs.

Financial.—(In '87.) Cost, $40,000. Debt, $12,000. Int., 7%. Ann. op. exp., $900. Ann. rev., about $1,000.

Management.—(In '88.) Com. of Three. Supt., S. C. Mentzer. Report by G. W. McDonald.

BLUFFTON, *Wells Co.* (Pop., 2,354; est., 3,500.) On Wabash river, 25 miles south of Ft. Wayne. Engaged in lumbering and manufacturing. Incorp. No sewers or electric lights.

History.—Built in '86 by town.

Water Supply.—Wells, in rock near Wabash river, direct pumping. Wells are 25 ft. deep, one being 30 x 80 ft., other 25 ft. in diam. Inflow, 4,000,000 galls. a day.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Gaskill dup. *Boilers:* steel.

Distribution.—*Mains*, c. i., 2¾ miles. *Services*, w. i. *Taps*, 220. *Meters*, none. *Hydrants*, Holly, 36. *Valves*, Ludlow.

Consumption, 200,000 galls. *Pressure:* Ordinary, 65 lbs. Fire, 80 lbs.

Financial.—Cost, $20,000. Bonded debt, $16,000. Int., 5%. Ann. op. exp., $1,350. Ann. rev.: consumers. $1,500; county, $200.

Management.—Three Trustees. Secy., C. J. Quick. Supt., J. F. M. Farren.

BRAZIL, *Clay Co.* (Pop., 3,441; est., 6,000.) Is 16 miles from Terre Haute, in Indiana bituminous coal region. Engaged in mining and iron manufacturing. Settled in '38; incorp. city in '72. No sewers. Has electric lights.

History.—Built in '75 by town. Des. Engr., Jno. McDowell.

Water Supply.—Surface water, by direct pumping from well 18 ft. in diam. x 20 ft. deep, sunk in coarse sand and gravel stratum.

Dam and Reservoir.—Cap., est., 12,000,000 galls.; area, 7 acres; av. depth, 5 ft. In '83 stone dam was built across valley 80 ft. from well; 69 ft. long, 8 ft. high. Unofficially reported that reservoir failed during flood of June 7.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; 1,000,000 Deane dup., 10-in.

Distribution.—*Mains*, c. i., 3¼ miles. *Services*, w. i. *Taps*, 220. *Meters*, none. *Hydrants*, kind not given, 39.

Consumption, 180,000 galls *Pressure:* Ordinary, 50 lbs. Fire, 80 lbs.

Financial.—Cost, $30,000. Debt, $28,000 Int., 9%. Ann. op. exp., $2,200. Ann. rev., $2,500.

Management.—Com. Chn., T. E. Hayes. Supt., Thos. Henderson.

COLUMBUS, *Bartholomew Co.* (Pop., 4,813; est., 8,000.) On Driftwood river, which is east fork of White river, 41 miles from Indianapolis. No sewers. Has electric lights.

History.—Built in '71 by town. Contrs., Holly Mfg. Co., Lockport, N. Y.

Water Supply.—Driftwood river, by direct pumping. Watershed of river is of sandstone and slate; river-bed is gravel.

Intake Conduit.—Is 450 ft. long, 16 ins. sq., of 2 in. white oak. It is close for 100 ft., remainder is perforated with 1½-in. holes. Top of box is 3 ft. below low water. This conduit filters into well under pump.

Pumping Machinery.—Dy. cap., 4,500,000 galls.; 1,500,000 Holly quadruplex, 3,000,000 Gaskill horizontal, cond.; latter added in '89.

Distribution.—*Mains*, c. i., 11 miles. *Services*, not given. *Taps*, 400. *Meters*, 1. *Hydrants*, kind not given, 70.

Consumption, 1,000,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 90 lbs.

Financial.—Cost, $52,000. Debt and int., not given. Ann. op. exp. $5,000, Ann. rev.: consumers, $5,300

Management.—Trustees. Secy., J. A. Trotter. Supt., F. P. Smith.

CONNERSVILLE, *Fayette Co.* (Pop., 3,223; est., 6,000.) On West fork of Whitewater river, on bottom lands, back of which bluff rises to height of 96 ft. Settled in '14; incorp. city in '69. No sewers or electric lights.

History.—Built in '69 by city. Engrs. and Contrs., Holly Mfg. Co., Lockport, N. Y.

Water Supply.—Hydraulic canal, formerly White Water Valley canal, by direct pumping.

Pumping Machinery.—Dy. cap., 4,000,000 galls.; three Root, rotary, water power. Formerly 1,000,000 Holly quadruplex; replaced in '89 by two Root.

Distribution.—*Mains*, c. i., 8 miles. *Services*, lead. *Taps* (in '82), 175. *Meters* none. *Hydrants* (in '87), Holly, 75.

Consumption, 400,250 galls. *Pressure:* Ordinary, 40 lbs. Fire, 80 to 90 lbs.

Financial.—(For '87.) Cost, $40,000. No debt. Ann. op. exp., $1,500. Ann. rev.: consumers (in '80-1), $1,200. In '82 city raised $550 by taxation, which, with half of water rents, was paid to owners of water-power for operating pumps.

Management.—Council. Supt., Jos. Hoover.

CRAWFORDSVILLE, *Montgomery Co.* (Pop., 5,251; est., 11,000.) On Sugar creek. Incorp. Has sewers and electric lights.

History.—Built in '86 (put in operation Dec. 16) by Crawfordsville Water Works Co. under a 20-years franchise. Chf. Engr., S. H. Lockett, N. Y. City. Asst. Engr., Jno. M. Walker, Lawrence, Kan. Contrs., Comegys & Lewis, N. Y. City. Co. also operates gas and electric light plants.

Water Supply.—Van Cleve Springs, flowing 3,000,000 galls. a day, by direct pumping and pumping to reservoir and stand-pipe.

Pumping Machinery.—Dy. cap., 4,000,000 galls.; Worthington; two 1,500,000 comp., non-cond., one 1,000,000 high-pressure.

Distribution.—(Jan. 1, '90.) *Mains*, c. i., 12¼ miles. *Services*, w. i. *Taps*, 550. *Meters*, 3. *Hydrants*, kind not given, 131.

Consumption, not given. *Pressure:* Ordinary, 110 lbs. Fire, 130 lbs.

Financial.—(Jan. 1, '90.) Cost, $425,000. Cap. stock, $200,000. Bonded debt, $285,000. Int., 6%. Sinking fund, 2% per annum after 10 years. Ann. op. exp., $12,600 Ann. rev.: consumers, $33,600; city, $5,330. Hydrant rental, $30.

Management.—Prest., Jno. S. Brown. Secy., Benj. Crane. Supt., Ira McConnell.

ELKHART, *Elkhart Co.* (Pop., 6,953; est., 15,000.) On St. Joseph river, at junction of Elkhart river and Christiana creek. On level ground; has good water-power used in manufacturing. Incorp. Partially sewered. Has electric lights.

History.—Built in '84 under 20-years franchise, by Elkhart Water Co., which is controlled by Fairbanks, Morse & Co., Chicago, Ill. Engr. for above company, M. M. Moore. Const. Engr., Geo. R. Harlow, of Pittsburgh (Pa.) Water and Gas Works Construction Co. Contrs., now Jas. H. Harlow & Co.

Water Supply.—Surface well, pumping to tank and direct. Well was built on an iron shoe, above ground, and sunk by excavating gravel to depth of 25 ft.; 30 ft. in diam., with brick curb 16 ins. thick, 24 ft. high. Gravel at this point is 32 ft. deep. Test of well showed dy. yield of 600,000 galls.

Pumping Machinery.—Dy. cap., 4,000,000 galls; two 3,000,000 Smith & Vaile, comp., dup. *Boilers:* from Putnam Furnace Co.

Tank.—Cap., 106,000 galls.; wood, 30 x 20 ft., on timber trestle 70 ft. high.

Distribution.—*Mains*, c. i., 12 miles. *Services*, lead. Pipe from Dennis Long & Co., Louisville, Ky. *Taps*, 700. *Meters*, 25. *Hydrants*, Chapman, Mathews, 125. *Valves*, Galvin, Eddy.

Consumption, 450,000 galls. *Pressure:* Ordinary, 38 lbs. Fire, 100 lbs.

Financial.—Cost, $115,000. Cap. stock, $100,000. Bonded debt. $100,000. Int., 6%. Ann. op. exp., $4,500. Ann. rev.: consumers, $5,500; city, $8,975. Hydrant rental, $75 for 109, $50 for 16.

Management.—Prest., C. H. Morse, Chicago, Ill. Secy. and Treas., C. A. Sharpe. Supt., C. H. Watson.

EVANSVILLE, *Vanderburgh Co.* (Pop., 29,280; est., 60,000.) On bluff on Ohio river, in coal region. Has cotton mill, furniture factories, foundries and other manufactories. Settled in '12; incorp. borough in '14, city in '47. Has sewers and electric lights.

History.—Built in '70-3 by city. Engrs. and Contrs., Holly Mfg. Co., Lockport, N. Y. Sub-Contr. for masonry and buildings, Geo. Laut

Water Supply.—Ohio river, by direct pumping.

Pumping Machinery.—Dy. cap., 5,000,000 galls. First pumps were gang of 12 piston pumps of 14-in. bore and stroke, driven by Holly engine. In '80, Gaskill engine and four 18-in. pumps of 36-in. stroke were erected. A 2,500,000 Worthington erected here.

Distribution.—*Mains*, c. i., 34 miles. *Services*, galv. i. *Taps*, 2,460. *Meters*, none. *Hydrants*, Holly, 280.

Consumption, 4,200,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—Cost, $400,000. Debt, $400,000. Int., 5%. Ann. op. exp., $21,357. Ann. rev.: consumers, $39.576; city, none.

Management.—Three Trustees. Secy., N. A. Riggs. Supt., Jno. Fetz.

FORT WAYNE, *Allen Co.* (Pop., 26,880; est., 40,000.) At confluence of Fort Wayne and St. Mary's rivers, which form the Maumee. Has extensive and varied manufactories. Has sewers and electric lights.

History.—Built in '79-80 by city. Des. Engr., J. D. Cook, Toledo, O. Const. Engr., C. S. Breckenridge. Contrs., R. D. Wood & Co.

Water Supply. Spy Run creek, through filter basin, direct pumping; also wells, added in '89.

Filter Basin.—Is 20 x 380 ft.; area, 38,950 sq. ft.; excavated in gravel to depth of 12 ft. below ordinary low water in Spy run, which it joins. Pipe connects with stream, so that water can be drawn from it if necessary.

Pumping Machinery.—Dy. cap., 9,000,000 galls.; 6,000,000 Gaskill triple comp., added in '89; Holly horizontal, dup., non-cond., 18 x 24 steam, 10-in. water cylinders; Holly quadruplex, 19 x 27-in. steam, 11-in. water cylinders; last two originally rated at 2,000,000 and 3,000,000 respectively.

Reservoirs.—Cap., 3,000,000 galls.; flow-line is 97 ft. above center of city. Probably reserve for fire protection. Contrs., Langolm & Battes.

Distribution.—*Mains*, c. i., 31 miles. *Services*, lead. Pipe and specials from and laid by R. D. Wood & Co., Philadelphia, Pa.; 20 miles laid by Inman Bros., N. Y. City. *Taps*, 1,978. *Meters*, Crown, Hersey, 160. *Hydrants*, Mathews, Ludlow, 260. *Valves*, Eddy, Ludlow. *Pressure-recording gauge*, Edson.

Consumption, 1,500,000 galls. *Pressure:* Ordinary, 50 lbs. Fire, 100 lbs.

Financial.—Cost (in '87), $314,000. Debt, $270,000. Int., 6%. Ann. op. exp., $10,000. Ann. rev.: consumers, $26,000. Original cost, $280,000.

Management.—Prest., Chas. McCullock. Secy., P. J. McDonald. Inspector, F. Iten.

COSHEN, *Elkhart Co.* (Pop., 4,123; est., 6,500.) On Elkhart river. Has good water-power used in manufacturing. Settled in '43; incorp. city in '67. Has sewers and electric lights.

History.—Built in '81 by town.

Water Supply.—Six artesian wells, 50 ft. deep, by direct pumping.

Pumping Machinery.—Dy. cap., 4,000,000 galls.; two 1,500,000 Deane, single, direct-acting.

Old Reservoir.—Brick, 28 ft. in diam. x 26 ft. deep. Water formerly pumped to this.

Distribution.—*Mains*, Wyckoff wood, 8½ miles. *Services*, galv. i. *Taps*, 500. *Meters*, none. *Hydrants*, Holly, Ludlow, 83. *Valves*, kind, do.

Consumption, 500,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—Cost, $66,000. Debt, $17,000. Int., 5%. Ann. op. exp., $3,200. Ann. rev.: consumers, $3,250; city, none.

Management.—Comrs. Prest., E. W. Hawks. Supt., Lew Wanner.

CREENCASTLE, *Putnam Co.* (Pop., 3,644; est., 9,000.) Has manufactories. Incorp. No sewers. Has electric lights.

History. Built in '86 by Greencastle Water-Works Co., under 20-years franchise. Engr., Ellis Morrison. Contrs., Saml. R. Bullock's Co. Both of N. Y City.

Water Supply.—Walnut creek, pumping to stand-pipe from impounding reservoir.

Reservoir.—No data.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two 1,500,000 Deane, comp., cond.

Stand-Pipe.—Cap., 398,000 galls.; is 22 x 140 ft.; from Tippett & Wood, Phillipsburgh, N. J.

Distribution.—*Mains*, c. i., 8½ miles. *Services*, w. i., lead. Pipe and specials from Dennis Long & Co., Louisville, Ky. *Taps* (in '87), 280. *Meters*, 2. *Hydrants* Ludlow, 85. *Valves*, Ludlow.

Consumption, not given. *Pressure:* Ordinary, 75 lbs. Fire, 150 lbs.

Financial.—Cost, $300,000. Cap. stock, $150,000. Bonded debt, $150,000. Int., 6%. Ann. op. exp. (in '87), $3,800. Ann. rev.: consumers (in '87), $7,580; city, $1,700. Hydrant rental, about $53.

Management.—Prest., D. E. Williamson. Secy. and Treas., W. Wood. Supt., J. W. Stubbs.

CREENSBURGH, *Decatur Co.* (Pop., 3,138; est., 6,000.) Engaged in milling and manufacturing. Incorp. city. No sewers. Has electric lights.

History.—Built in '89 by Greensburgh Water Co., under 30-years franchise; put in operation about Jan. 1, '90. Des. Engr., E. F. Fuller, N. Y. City. Const. Engr., Geo. E. Stevens.

Water Supply.—Tube wells, direct pumping.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; two comp., non-cond.

Distribution.—*Mains*, 8-in. c. i.; from Dennis Long & Co., Louisville, Ky. *Hydrants*, Ludlow, 100. *Valves*, Ludlow.

Pressure: Ordinary, 70 lbs. Fire, 150 lbs.

Financial.—Cost, $100,000. Cap. stock, $100,000. Bonds, $100,000. Hydrant rental, $35.

Management.—No data.

HAMMOND, *Lake Co.* (Pop., est., 4,000.) On Grand Calumet river. Manufactures whiskey, syrup, chemicals, flour, brick, nails and carriages. Incorp. Has sewers and electric lights.

History.—Built in '88 by town. Contrs., E. B. Wingate, Winfield, Kans., and Jno. Grubbins, Chicago, Ill.

Water Supply.—Well, pumping to stand-pipe. Main to Lake Michigan, five miles distant, projected in '89.

Pumping Machinery.—Dy. cap, 1,500,000 galls.; Worthington.

Stand-Pipe.—No data.

Distribution.—*Mains*, kind not given, 5 miles. *Taps*, 300. *Meters*, 6. *Hydrants*, kind not given, 70.

Consumption, 200,000 galls. *Pressure*, 40 to 120 lbs.

Financial.—Cost, $60,000. Debt, $36,000. Int., 6%. Ann. op. exp., $3,000. Ann. rev.: consumers, $3,000.

INDIANAPOLIS, *Marion Co.* (Pop., 75,056; est., 120,000.) On east bank of river, on plain sloping upwards to southwest about 15 ft. to the mile; about 30 ft above low water at river. On bed of gravel 30 to 60 ft. deep, underlaid with 5 to 10 ft. of clay, beneath which is another bed of gravel. Ground water in upper gravel rises from river level about 20 ft. to mile, and furnishes large part of water used for domestic purposes. It is badly contaminated by drainage. City was founded in '19. Has sewers and electric lights.

History.—Built in '70 by private company, name not given, when population was 30,000. In '80 or '81 works were sold at sheriff's sale to Indianapolis Water Co., who improved and extended system according to recommendations by J. J. R. Croes, N. Y. City. J. H. Dennis was Res. Const. Engr. of extensions. In '89 important extensions were projected, including new pumps and force-mains.

Water Supply.—Filter gallery on bank of White river, by direct pumping. Water was first taken from two wells near river, 20 ft. in diam. and 80 ft. apart, sunk 10 ft. below low water in river and connected by tunnel. In one of wells a 4-in. pipe was driven 80 ft., but this gave small yield, and water from the lower stratum was strongly impregnated with mineral salts.

This supply soon became inadequate, and water was then drawn directly from river at concave bend. Drainage from mills and factories passed close to bank and over intake pipe. In '79 a crib filled with stone was sunk in river and covered with gravel. It was 25 x 50 ft., and 4 ft. high, suction pipe connecting with one end. Object of the crib was to provide filtered water. May 14, '81, crib broke, and considerable sand was drawn through whole system.

Filter Gallery.—Is 2,000 ft. long, partly covered; about 1½ miles from pump-well.

Pumping Machinery.—Dy. cap., 22,000,000 galls.; Holly and Gaskill water-power. *Boilers:* Holly.

Co. owns an old canal, now used for water-power only; when works were started three turbine wheels were used to drive three rotary and six single-acting Holly pumps. Supplementary Holly steam engine was used. In '80, Holly engine with four inclined 34 x 37 in. steam cylinders, connected to fly-wheel, and four 15-in. pumps were erected, old pumps being badly worn. Since works were started pumps with following cap. have been in use: 6,000,000 Holly quadruplex, two 5,000,000 Gaskill water-power, 12,000,000 Gaskill horizontal, latter added in '88-9.

Distribution.—*Mains*, c. i., 78 miles. *Services*, lead. *Taps*, 2,245. *Meters*, 350. *Hydrants*, Murdock, Holly, Mathews, 660.

Consumption, 5,500,000 galls. *Pressure:* Ordinary, 55 to 60 lbs. Fire, 120 lbs.

Financial.—Cost, $2,000,000. Cap. stock, $500,000. Bonded debt, $350,000. Int., 6%. Ann. op. exp., withheld; est., $25,000. Ann. rev.: consumers, $78,855; city, $32,374. Hydrant rental, $50.

Management.—Prest., Thos. A. Morris. Secy., M. A Morris. Supt., V-Prest. and Treas., F. A. W. Davis.

Reference.—Tenth Census U. S., vol. XVII., Water Supply of Cities, pp. 46-7.

JEFFERSONVILLE. *Clark Co.* (Pop., 9,307; est., 15,000.) On Ohio river opposite Louisville, Ky. Engaged in manufacturing. Has electric lights.

History.—Built in '87-8 by Jeffersonville Water Supply Co., under 50-years franchise. Engr., E. F. Fuller, N. Y. City. Res. Const. Engr., Geo. C. Stevens. Contr., Saml. R. Bullock, N. Y. City.

Water Supply.—Ohio river, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two 1,500,000 Holly, comp., cond.

Stand-Pipe.—Cap., 199,000 galls.; 15 x 150 ft.; from Tippett & Wood, Phillipsburgh, N. J.

Distribution.—(In '88.) *Mains*, 14 to 6-in. c. i., 10 miles. *Services*, w. i., lead. Pipe and specials from Dennis Long & Co., Louisville, Ky. *Taps*, not determined. *Hydrants*, Ludlow, 110. *Valves*, Ludlow.

Financial.—(In '88.) Cost, withheld, est., $150,000. Cap. stock, $200,000. Bonds, $200,000. Int., 6%. Ann. rev.: consumers, not determined time of report. Hydrant rental, total, $6,250, or $56.81 each.

Management.—(In '88.) Prest., E. Woltmann, 11 Wall St., N. Y. City. Treas., N. P. Hobart. Secy., C. M. Berrian.

NOTE.—No reply to inquiries sent in '89.

KENDALLVILLE, *Noble Co.* (Pop., 2,287; est., 3,000.) Has various manufactories.

History.—Completed Dec. 31, '87, by city. Des. Engr., J. D. Cook, Toledo, O.

Water Supply.—Well, by direct pumping.

Pumping Machinery. Dy. cap., 750,000 galls.; Knowles, comp., cond. *Boilers:* two, horizontal, tubular.

Distribution.—*Mains*, c. i., 2 miles. *Services*, w. i. Pipe and specials from R. D. Wood & Co., Philadelphia, Pa.; trenching and pipe-laying done by Snyder & Williams, Dayton, O. *Taps*, 63. *Meters*, none. *Hydrants*, Mathews, 21. *Valves*, Flower.

Consumption, 7,000 galls. *Pressure*, 60 to 90 lbs.

Financial.—Cost, $18,000. Debt, $13,000. Int., 6%. Ann. op. exp., $1,800. Ann. rev.: consumers, $600.

Management.—Prest. Water Board, D. C. Walling. Supt., H. Krueger.

KOKOMO, *Howard Co.* (Pop., est., 8,000.) On Wildcat river. Engaged in lumbering and manufacturing. Has natural gas wells. Incorp. Has sewers and electric lights.

History.—Built in '87-8, under 15 years franchise, by Kokomo Water-Works Co., which is controlled by American Water-Works and Guarantee Co., Ltd., Pittsburgh, Pa. Contr. for buildings and pipe-laying, A. W. Stevens, Logansport.

Water Supply.—Artesian wells and Wildcat creek, by direct pumping.

Pumping Machinery.—Dy. cap., 5,500,000 galls.; 3,000,000 Deane, 2,500,000 Smith & Vaile, added in '89.

Distribution.—*Mains*, c. i., 11 miles. *Services*, galv. i. *Taps*, 401. *Meters*, not given. *Hydrants*, Ludlow, 152. *Valves*, Ludlow.

Consumption, 250,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 90 lbs.

Financial.—Cost, $102,000. Cap. stock, $125,000. Bonded debt, $85,000. Int., 5%. Ann op. exp. and rev., not determined at time of report. Hydrant rental, $28.33.

Management.—Prest., S. M. Highlands. Secy., W. S. Kuhn. Both of Pittsburgh, Pa. Supt., C. H. Taylor.

LA FAYETTE, *Tippecanoe Co.* (Pop., 14,860; est., 17,000.) On Wabash River, on rolling ground. Has water-power used in manufacturing. Incorp. in '25. Has sewers and electric lights.

History.—Built in '75-6 by city. Engr., Henry Earnshaw, Cincinnati, O.

Water Supply.—Wabash river, pumping to reservoir and direct, and to standpipe for fire pressure in highest part of city.

Intake.—Caisson sunk in river.

Pumping Machinery.—Dy. cap., 5,000,000 galls.; Clapp & Jones; double beam cond. engine, driving two 9-in. double-acting pumps with cap. of 2,000,000; single beam comp., cond. engine driving 16-in. double-acting pump, with cap. of 3,000,000.

Force Main.—Diam., 16 ins.; length, 10,000 ft.

Reservoir.—Cap., 5,000,000 galls. First reservoir was 69 x 120 ft., in earth embankment above natural surface. Inner slopes puddled with clay and paved with cobble stones grouted with cem. Bottom covered with 1 ft. of concrete. Contrs., Wm. Wallace & Bros., La Fayette.

Stand-Pipe.—Cap., 243,000 galls.; 24 x 72 ft., in centre of reservoir.

Distribution.—*Mains*, c. i., 17½ miles. *Services*, lead. Pipe and specials from Lake Shore Foundry, Cleveland, O.; trenching and pipe-laying done by Wm. Wallace & Bros. La Fayette. *Taps*, 1,169. *Meters*, 13. *Hydrants*, Ludlow, 200. *Valves*, Ludlow.

Consumption, 1,400,000 galls. *Pressure*, av., 60 lbs.

Financial.—Cost (in '87), $360,000. Bonded debt, $300,000. Int., 8%. Ann. op. exp., $7,000. Ann. rev.: consumers, $17,800; city, none. Rev. (in '89), $11,506.

Management.—Three Trustees. Prest., W. F. Frey. Supt., E. Cunningham.

LA PORTE, *La Porte Co.* (Pop., 6,195; est., 10,000.) On high plateau on border of Clear lake, one of chain of 7 small lakes. Is 59 miles from Chicago. Settled in '30, incorp. city in '52. Has sewers and electric lights.

History.—Built in '70 by city. Engr., Birdsall Holly, of Holly Mfg. Co., Lockport, N. Y., Contrs.

Water Supply.—Clear lake, by direct pumping. Lake is 4 x 7 miles.

Intake Conduit.—Wood, 16 ins. in diam., x 800 ft. long, ending in 4 ft. of water.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; Holly; first there were six 12 x 12-in. piston pumps, and two rotary for fire protection. It is not stated whether additions have been made.

Distribution.—*Mains*, c. i., 18 miles. *Services*, w. i., lead. *Taps*, 700. *Meters*, none. *Hydrants*, mostly Holly, some Mathews, 110. *Valves*, Ludlow.

Consumption, 800,000 galls. *Pressure:* Ordinary, 30 lbs. Fire, 100 lbs.

Financial.—Cost, $150,000. Debt, $50,000. Int., 7%. Ann. op. exp., $6,000. Ann. rev.: consumers, $8,000.

Management.—Three Trustees. Secy., J. B. Silliman. Supt., G. H. Storey.

LIGONIER, *Noble Co.* (Pop., 2,010, est., 2,500.) On Elkhart river, 25 miles from Elkhart. Has manufactories. Incorp. No sewers or electric lights.

History.—Built in '88-9 by village; put in operation April 1, '89. Engr. W. E. Hinsdale, Beloit, Wis. Contrs., Fairbanks, Morse & Co., Chicago.

Water Supply.—Well, pumping to tank and direct.

Pumping Machinery.—Dy. cap., 500,000 galls; Deane.

Tank.—Cap., 50,000 galls.

Distribution.—(April 1, '89.) *Mains*, 8 to 4-in. c. i., 2 miles. *Taps*, 50. *Hydrants*, Mathews, 18.

Consumption, 12,000 galls. *Pressure*, not given.

Financial.—Cost, $15,000. Debt, $14,000. Int., 6%. Ann. op. exp. and rev., not determined.

Management.—Trustees. Prest., H. R. Cornell. Secy., E. B. Gerber. Supt., M. Nippert.

LOGANSPORT, *Cass Co.* (Pop., 11,198; est., 18,500.) On Wabash, at mouth of Eel river, business part of city being between and 40 ft. above rivers. Two miles back ground rises to a height of 200 ft. Railroad center. Settled in '28; incorp. city in '38. Sewers contemplated in '89. Has electric lights.

History.—Built in '75-6 by city. Des. Engr., Henry Earnshaw, Cincinnati, O. Const. Engr., Walter A. Osmer, Logansport. Contr., H. R. Smith & Co., except for buildings and pumps; Contrs. for latter, Cope & Maxwell, Hamilton, O.

Water Supply.—Eel river, by direct pumping. Drainage area, about 3,000 sq. m.

Dam.—Timber, to give water-power.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; four 11 x 24-in. Cope & Maxwell piston water-power, with auxiliary engines. *Water-wheels:* two 54-, one 40-in. turbine. Latter part of '89 bids were asked for 2,000,000 additional pumps.

Distribution.—*Mains*, c. i., 15 miles. *Services*, lead. *Taps*, 875. *Meters*, none *Hydrants*, Ludlow, 106. *Valves*, Ludlow.

Consumption, 1,125,000 galls. *Pressure:* Ordinary, 50 lbs. Fire, 100 lbs.

Financial.—Cost, $250,000. Debt, $160,000. Int., 6%. Ann. op. exp., $4,500. Ann. rev.: consumers, $12,000; city, $5,300. Hydrant rental, $50.

Management.—Three Trustees. Prest., J. T. Obenchain. Secy., S. McGovern.

MADISON, *Jefferson Co.* (Pop., 8,945; est., 10,000.) On Ohio river. Engaged in manufacturing. Incorp. town in '25, and city in '38. Has electric lights.

History.—Built in '49 by city. Des. Engr., Thos. J. Goodman. Const. Engr., Theo. R. Scowden. Rebuilt or extended by city in '71-2, under direction of Trustees Jno. Kirk, J. W. Hinds and J. T. Alison; Cobb & Stribling, Madison, Engrs.

Water Supply.—Ohio river, pumping to reservoir. Formerly dam across ravine impounded surface water in reservoir holding about 6,000,000 galls. Supply was then from this, and from Ohio river.

Pumping Machinery.—Dy. cap. and make not given; two double-acting, 9¼ x 72-in. piston.

Reservoirs.—In '82, two were in use, one 80 ft. in diam. x 20 ft. deep, other 73 ft. in diam. x 16 ft. deep. Each was 212 ft. above river.

Distribution.—(In '87.) *Mains*, c. i., 12 miles. *Services*, w. i. *Taps*, 700. *Meters*, none. *Hydrants*, Galvin, Ward & McClellan, 240. *Valves*, kind, do.

Consumption (in '86), 465,000 galls. *Pressure*, 85 lbs.

Financial.—(In '87.) Cost, $250,000. Bonded debt, 8%. Ann. op. exp. (in '86), $6,500. Ann. rev.: consumers (in '86), $7,000.

Management.—Three Trustees. Prest. and Supt. (in '88), W. W. Hinds.

MARION, *Grant Co.* (Pop., 3,182; est., 11,000.) On level ground, on Mississinewa river, in gas belt. Incorp. Has sewers and electric lights.

History.—Built in '77 by city. Engr., J. D. Cook, Toledo. Contrs., Dean Bros., Indianapolis.

Water Supply.—Well, by direct pumping. Well 25 ft. in diam., with brick curb 16 ins. thick, built on timber shoe and sunk 26 ft. in gravel by excavating from inside. Pipe was driven 42 ft. through hardpan to another water-bearing stratum, water from which rose 16 ft above surface of ground.

Pumping Machinery.—Dy. cap., 3,500,000 galls.; two Deane; a dup., high pressure, with 18 x 14-in. steam, 10-in. water cylinders; also one with 20 x 12-in. steam cylinder, 14-in. plunger.

Distribution.—*Mains*, c. i., 10 miles. *Services*, lead. *Taps*, 380. *Meters*, none. *Hydrants*, Ludlow, 65.

Consumption (in '84), 250,000 galls. *Pressure:* Ordinary, 25 to 30 lbs. Fire, 60 to 80 lbs.

Financial.—Cost, $45,000. Debt, $20,000. [In '87, $30,000; not $2,000.] Int., 6%. Ann. op. exp., $2,000. Ann. rev., $3,500.

Management.—Trustees. Prest. and Supt., D. H. Sanders. Secy., H. F. Clunk.

MICHIGAN CITY, *La Porte Co.* (Pop., 7,335; est., 10,000.) On Lake Michigan at the mouth of Trail creek. Engaged in lake commerce, lumber trade and manufacturing. Settled in '33; incorp. city in '35. Has sewers and electric lights.

OLD WORKS.

General Description.—Built in '75 by city after plans by Daniel Kennedy. A 1,500,000-gall. Worthington pump lifted water 80 ft. from Trail creek, near its mouth, to wooden tank 28 x 14 ft., having cap. of 64,481 galls., and elevation above city of from 40 to 72 ft. By direct pumping fire pressure of 100 lbs. was obtained. Old distribution was retained for new works, rest of plant being abandoned.

PRESENT WORKS.

History.—Finished Sept. 1, '88, by city. Engr., Geo. C. Morgan, Chicago. Contrs., Ravell & Pipple.

Water Supply.—Crystal springs, pumping to tank and direct.

Pumping Machinery.—Dy. cap., 3,500,000 galls; 2,000,000 Gaskill dup. *Boilers:* two 60-H. P., steel.

Tank.—Cap., 120,000 galls; from Contrs.

Distribution.—*Mains*, c. i., 12 miles. *Services*, galv. i., lead. Pipe and specials from Dennis Long & Co., Louisville, Ky. *Taps*, 260. *Meters*, 3. *Hydrants*, Flower, 102. *Valves*, Flower.

Consumption, 800,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 120 lbs.

Financial.—Cost, $60,000, for old and new works. Debt, $15,000. Int., 6%. Ann. op. exp., $4,000. Ann. rev.: consumers, $4,400.

Management.—Three Trustees. Secy., H. Fish. Supt., J. Renkawitz.

MISHAWAKA, *St. Joseph Co.* (Pop., 2,640; est., 4,000.) On St. Josephs river, 4 miles from South Bend. Has manufactories. Incorp. No sewers or electric lights.

History.—Built in '73 for fire protection, street and lawn sprinkling, and extended in '83 and '89 by Perkins Windmill & Axe Co. Engr., P. C. Perkins, Mishawaka. No Contrs. for labor. Construction of system by town was under consideration in '89. **Water Supply.**—St. Joseph river, by direct pumping. **Pumping Machinery.**—Dy. cap., 1,000,000 galls.; Holly, double-acting, piston, water-power, with auxiliary steam engine. **Distribution.**—*Mains*, 6 and 4-in. c. i., 2½ miles. *Services*, w. i. *Taps*, 52. *Meters*, none. *Hydrants*, Indianapolis, 26. *Consumption*, not given. *Pressure:* Ordinary, 40 lbs. Fire, 90 lbs. **Financial.**—Cost, withheld, est., $20,000. No debt. Ann. op. exp., $325. Ann. rev.: consumers, $150; city, $300. Hydrant rental about $14. **Management.**—Prest., P. C. Perkins. Supt., M. M. Fisher.

MOUNT VERNON, *Posey Co.* (Pop., 2,730; est., 5,000.) On Ohio river about 18 miles below Evansville. Incorp. Has sewers and electric lights.

History.—Built in '60, under 20-years franchise, by Mount Vernon Water Co., controlled by American Water-Works & Guarantee Co., Ltd., Pittsburgh, Pa.

Water Supply.—Ohio river, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; Blake.

Stand-Pipe.—Cap., 175,000 galls.; from Tippett & Wood, Phillipsburgh, N. J.

Distribution.—*Mains*, c. i., 9 miles. *Services*, galv. i. *Taps*, 450. *Meters*, not given. *Hydrants*, Ludlow, 75. *Valves*, Ludlow.

Consumption, 175,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 100 lbs.

Financial.—Cost, withheld, est., $100,000. Cap. stock, $60,000. Bonded debt, $60,000. Int., 6%. Ann. op. exp., $2,500. Ann rev.: consumers, $5,000; city, $3,500. Hydrant rental, $46.66.

Management.—Supt., E. M. Lord. Gen. Mgr., W. S. Kuhn, Pittsburgh, Pa.

MUNCIE, *Delaware Co.* (Pop., 5,219; est., 9,000.) On White river. Has bagging, bent wood, and other manufactories. Incorp. Has sewers and electric lights.

History.—Built in '85, under 20-years franchise, by Muncie Water-Works Co. operated by American Water-Works & Guarantee Co , Ltd., Pittsburgh, Pa.

Water Supply.—Artesian wells, by direct pumping from settling basin.

Settling Basin.—Not described.

Pumping Machinery.—Dy. cap., 4,500,000 galls.; Worthington. *Boilers:* tubular.

Distibution.—*Mains*, c. i., 14 miles. *Services*, galv. i. *Taps*, 450. *Meters*, none. *Hydrants*, Ludlow, 85. *Valves*, Ludlow.

Consumpton, 500,000 galls. *Pressure:* Ordinary, 50 lbs, Fire, 100 lbs.

Financial.—(In '87.) Cost, withheld, est. $145,000. Cap. stock, $100,000. Bonded debt, $83,000. Int 6%. Ann. op. exp., $1,850, natural gas being used for fuel. Ann. rev.: consumers, $5,000; city, $5,000 on 7 miles of pipe.

Management.—Prest., W. S. Kuhn, Pittsburgh, Pa. Secy. and Treas., J. H. Purdy.

NEW ALBANY, *Floyd Co.* (Pop., 16,423; est., 30,000.) On north bank of Ohio river, 4 miles below Louisville, Ky., 2 below falls of 29 ft., which afford water-power used in manufacturing. City is on two benches, or plains, rising gradually from river. Manufactures glass, iron, woolen and cotton goods. Laid out in '13; incorp. city in '39. No sewers. Has electric lights.

History.—Built in '75 by New Albany Water-Works Co. Engr., Frank Schefold, Supt. since works were built. Contr., D. C. Hill, deceased. Sub-contr., for masonry, buildings and reservoir, David Conger.

Water Supply.—Ohio river, pumping to settling reservoirs.

Intake Pipe.—Is 12 ins. in diam., laid to channel of river with strainer on its outer end.

Pumping Machinery.—Dy. cap., 2,500,000 galls.; from Chas. Hegewald; single-acting beam and fly-wheel engine with 26-in. steam cylinder driving two 16 x 60-in. plunger pumps, placed 50 ft. below engine room floor.

Settling Reservoirs.—Cap., 9,000,000 galls.; depth, 14 ft.; elevation, 192 ft. above city; 3 basins in excavation and embankment, side by side; first two have cap. of 1,500,000 galls. each; third, 6,000,000, at right angles to others. Banks of heavy, yellow clay, carted on in 6-in. layers and wet; no heart-wall; 16 ft. high, 12 ft. wide on top, 60 at bottom. Both slopes, 1½ to 1, inner paved with two layers brick on edge in cem.; outer, sodded. *Discharge-pipes:* two 18-in. Water pumped to largest basin, passes slowly to second and third basins; discharges into vertical pipe, outside and 6 ft. below bottom of reservoir, latter for aeration; water not good till this method was adopted. Res rvoir does not leak. Built in '75. Engr. and Contr., see History. Cost, $16,000.

Distribution.—*Mains*, c. i., 21 miles. *Services*, lead. Pipe and specials from Dennis Long & Co., Louisville, Ky.; trenching and pipe-laying done by Thos. Mathews. *Taps*, 1,200. *Meters*, 60. *Hydrants*, Mathews, 165.

Consumption, 1,000,000 galls. *Pressure*, 80 lbs.

Financial.—(For '87.) Cost, $265,000. Cap. stock, $150,000. Bonded debt, $150,000. Int., 7%. Ann. op. exp., $7,000. Ann. rev.: consumers, $30,000; city, $13,975. Hydrant rental, $100 for first hundred, $75 for additional.

Management.—Prest., C. H. Fawcett. Secy. and Treas., E. C. Hungary.

NEW CARLISLE, *St. Joseph Co.* (Pop., 530; est., 1,000.) Settled in '40.

History.—Built in '79 by town. Engr. and Contr., Geo. C. Morgan, Chicago, Ill.

Water Supply.—Well, pumping to tank, and in case of fire, direct. Well is 10 ft. in diam., 35 ft. deep, and 4 2½-in. pipes are driven in bottom. Water stands in well 12 ft. deep.

Pumping Machinery.—Dy. cap., 250,000 galls.; 7-in. Worthington dup.

Tank.—Cap., 35,000 galls.; wood, 18 x 22 ft , x 25 ft. high; on timber trestle.

Distribution.—(In '87.) *Mains*, 6 to 3-in. Wyckoff wood, 2 miles. *Services*, galv. i. *Taps*, 100. *Meters*, none. *Hydrants*, Morgan. *Valves*, Crane.

Consumption, 20,000 galls. *Pressure*, Ordinary, 36 lbs. Fire, 80 to 100 lbs.

Financial.—(In '87.) Cost, $10,400. Bonded debt, $4,500. Int., 7%. Ann. op. exp., $575. Ann. rev.: consumers, $400; city, none.

Management.—(In '88.) Three Comrs. Secy., Geo. L. Sipe. Supt., D. A. White.

NOTE.—No reply to inquiries sent in '89.

NEW CASTLE, *Henry Co.* (Pop., 2,299; est., 3,000.) Has manufactories.

History.—Built in '89 by city. Engr., J. D. Cook, Toledo.

Water Supply.—Well, by pumping.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; two 750,000 Gaskill dup.

Distribution.—Pipe from Addyston Pipe and Steel Co.

Financial.—Cost (an early est.), $25,000.

Management.—Comrs. Supt., Geo. T. Melle.

PERU, *Miami Co.* (Pop., 5,280; est., 10,000.) On Wabash river, on level ground extending back about ½ mile to bluffs about 100 ft. high. Engaged in manufacturing. Settled about '20. Incorp. Has sewers and electric lights.

History.—Built in '79 by city. Engr., J. D. Cook, Toledo, O. Contrs. for masonry and fonndations, Jno. Clifton & Co., Peru.

Water Supply.—Wabash river, pumping to reservoir.

Intake Pipe.—C. i., 20-in., 370 ft. long, connecting by gravity crib in river with pump-wells.

Pump-Wells.—Two, brick in cem., 5 ft. diam., 22 ft. deep.

Pumping Machinery.—Dy. cap., 2,500,000 galls.; two Worthington; 1,500,000 comp., dup., cond., 1,000,000 non-cond.

Force Main.—A 12-in. pipe 2,446 ft. long; rise, 93 ft.

Reservoir.—Cap., 1,250,000 galls; area, 5 acres; ½ mile from pump-house. About 116 ft. above river. Contrs., Earnshaw, Peters & Scully, Cincinnati, O.

Distribution.—*Mains*, 16 to 4-in. c. i., 12.2 miles. *Services*, lead. Pipe and specials from Dennis Long & Co., Louisville, Ky.; trenching and pipe-laying done by Jno. Knight, Indianapolis. *Taps*, 466. *Meters*, Crown, 2. *Hydrants*, Mathews, Whittier, Lowry, 101. *Valves*, Eddy.

Consumption, 631,674 galls. *Pressure:* Ordinary, 42 lbs. Fire, 70 lbs.

Financial.—Cost, $127,592. Debt, $100,000. Int., 8%. Ann. op. exp., $4,182. Ann. rev.: consumers, $8,529.

Management.—Three Trustees. Secy., P. V. Gardner. Supt., Jno. Steward.

PLYMOUTH, *Marshall Co.* (Pop., 2,570; est., 3,500.) In agricultural region. No sewers. Has electric lights.

History.—Built in '88 by village. Des. Engrs., J. M. Confer, Plymouth, S. V. Saleno, Bay City. Const. Engrs. and Contrs., Michigan Pipe Co., Bay City, Mich., A. L. Holmes, Grand Rapids, Mich. Sub-contrs. for driven wells, McAdams & Co.; for pump-well and buildings, Price & Stamberg. Both of Plymouth.

Water Supply.—Four 4 in. and one 2-in. driven well from which water flows to cistern, thence by direct pumping.

Cistern.—Cap., 20,000 galls.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Gaskill dup.

Distribution.—*Mains*, Wyckoff wood, iron, 3¼ miles. *Taps*, 93. *Meters*, none. *Hydrants*, Holly, 30. *Valves*, Galvin.

Consumption, 18,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 120 lbs.

Financial.—Cost, $17,800. Debt, $16,000. Int., 5%. Ann. op. exp., $1,600. Ann. rev.: consumers, $475.

Management.—Prest. and Supt., J. Miller. Secy., I. D. Buck.

RICHMOND, *Wayne Co.* (Pop., 12,742; est., 17,000.) Has various manufactories. Incorp. Partially sewered. Has electric lights.

History.—Built in '86 by Richmond City Water-Works Co., under unlimited franchise. Contrs., S. L. Wiley Construction Co.

Water Supply.—Springs, pumping to reservoir and direct.

Pumping Machinery.—Dy. cap., 4,000,000 galls.; Gaskill horizontal.

Reservoir.—Cap., 9,000,000 galls.

Distribution.—*Mains*, c. i., 25 miles. *Services*, galv. i. *Taps*, 1,050. *Meters*, 21. *Hydrants*, Mathews, 180. *Valves*, Ludlow.

Consumption, 1,000,000 galls. *Pressure:* Ordinary, 70 lbs. Fire, 200 lbs.

Financial.—Cost, $400,000. Cap. stock, $250,000. Bonded debt, $200,000. Int., 6%. Ann. op. exp., $6,000. Ann. rev.: consumers (in '87), $8,000; city, $10,690. Hydrant rental, $60 for 170, $49 for remainder.

Management.—Prest., D. K. Zeller. Treas., W. P. Hutton. Secy., J. B. Craighead. Supt., F. M. Curtis.

ROCKPORT, *Spencer Co.* (Pop., 2,382; est., 3,000.) On Ohio river. No sewers Has electric lights owned by Water Co.

History.—Built in '86 by Rockport Water-Works Co., under 50-years franchise; put in operation Sept. 18. Engr., A. H. Kennedy, Supt.

Water Supply.—Ohio river, pumping direct and to stand-pipe.

Pumping Machinery.—Dy. cap., 750,000 galls.; Smith & Vaile, dup.. 16x10x10 ins.

Stand-Pipe.—Cap., 140,000 galls.; 20x60 ft.

Distribution.—*Mains*, 8 to 4-in. c. i., 3 miles. *Services*, galv. i. Pipe and specials from Dennis Long & Co., Louisville, Ky. *Taps*, 160. *Meters*, Hersey, 3. *Hydrants*, Ludlow, 17. *Valves*, Ludlow.

Consumption, not given. *Pressure:* Ordinary, 40 to 60 lbs. Fire, 100 lbs.

Financial.—Cost, $25.000. Cap. stock, paid up, $25,000. Bonded debt, $16,000. Int., 6%. Ann. op. exp., $500. Ann. rev.: consumers, $2,000; city, $622. Hydrant rental, $40 for 10, $30 for 7; 25-years contract.

Management.—Prest., S. W. Stocking. Secy., Treas. and Supt., A. H. Kennedy. Report, Jan. 23, '90.

SALEM, *Washington, Co.* (Pop., 1,615; est., 2,000.) On Great Blue river. Has manufactories and large stone quarry.

History.—Built in '86 by town. Des. Engr., Jno. M. Henderson, Omaha, Neb. Contr., M. Shrunn, Salem.

Water Supply.—Spring, two miles from town, pumping to reservoir, with direct pumping for fire protection.

Pumping Machinery.—Dy. cap., 500,000 galls.; Deane.

Reservoir.—Cap., not given; 80 x 120 ft., x 10 ft. deep.

Distribution.—(In '87.) *Mains*, c. i., 3 miles. *Services*, w. i. *Taps*, 160. *Meters*, none. *Hydrants*, Bailey, 12. *Valves*, Eddy.

Consumption (in '87), 10,000 galls. *Pressure*, 50 to 120 lbs.

Financial.—(In '87.) Cost, $16,000. Debt, $12,000. Int., 5¼%. Ann. op. exp., $500. Ann. rev.: consumers, $600; city, free.

Management.—(In '88.) Trustees. Secy., J. B. Berkey. Supt.. E. Craycroft.

NOTE.—No reply to inquiries sent in '89.

SHELBYVILLE, *Shelby Co.* (Pop., 3,745; est., 5,000.) On Blue river, 26 miles. from Indianapolis. Engaged in manufacturing and trade. Incorp. No sewers. Has electric lights.

INDIANA WATER & LIGHT CO.

General Description.—Formed in '89 or '90 to operate works here and at Warsaw. Debt, $150,000. Int., 6%. Sinking fund, 2% per annum after 10 years. Prest., Chas. Whann. Secy., Jas. Greely. Treas., Chas. B. Ludwig. See below; also Warsaw.

LOCAL PLANT.

History.—Built in '86 by Shelbyville Water-Works Co., under 20-years franchise. Chf. Engr., S. H. Lockett, N. Y. City. Asst. Engr., Jno. M. Walker, Lawrence, Kan. Contrs., Comegys & Lewis, N. Y. City. See Indiana Water & Light Co., above.

Water Supply.—Well pumping to stand-pipe. Well is near Blue river in sand and gravel, 35 ft. diam., 33 ft. deep.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two 1,000,000 Worthington, comp., dup. *Boilers:* two 50-H. P., tubular, from Sinker, Davis & Co., Indianapolis.

Stand-Pipe.—Is 5 ft. diam. x 125 ft. high.

Distribution.—*Mains*, c. i., 7¼ miles. *Services*, galv. i. *Taps*, 470. *Meters* none. *Hydrants*, kind not given, 74. *Valves*, Eddy.

Consumption (in '87), 22,500 galls. *Pressure:* Ordinary, 50 lbs. Fire, 120 lbs.

Financial.—Cost, $105,000. Debt, see Indiana Water & Light Co.. above. Int., 6%. Ann. op. exp., $2,000. Ann. rev.: consumers, $6,400; city, $4,000. Hydrant rental, $35.

Management.—See Indiana Water & Light Co., above.

SEYMOUR, *Jackson Co.* (Pop., 4,250; est., 7,500.) Has manufactories and Ry. shops. Incorp. city. Sewers under construction in '90. Has electric lights.

History.—Built in '89 by Seymour Water Co.; put in operation Sept. 12. Engr., S. H. Lockett, N. Y. City. Asst. Engr., E. S. Simpson. Contr., Willet E. McMillan, Paris, Ill.

Water Supply.—East fork White river, pumping direct and to stand-pipe.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two Smith & Vaile, comp., dup. *Boilers:* from Atlas Engine Works, Indianapolis.

Stand-Pipe.—Cap., 150,000 galls.; 16x100 ft., from Porter, Jackson & Co., So. Chicago, Ill.

Distribution.—*Mains*, 12 to 6-in. c. i., 10 miles. *Services*, galv. i. Pipe and specials from Dennis Long & Co., Louisville, Ky. *Meters*, Crown, 3. *Hydrants*, Bourbon, 101. *Valves*, Bourbon.

Pressure: Ordinary, 55 lbs. Fire, 100 lbs.

Financial.—Cost, withheld, est., $90,000. Cap. stock, $80,000. Bonded debt, $80,000. Int., 6%. Ann. op. exp., est., $2,300. Ann. rev.: est. for '90, $3,700; city, $1,535. Hydrant rental, $45 for 100, $35 for additional; 30-years contract.

Management.—Prest. and Supt., Judson A. Lamon. Treas., Ben. F. Price.

SOUTH BEND, *St. Joseph Co.* (Pop., 13,280; est., 23,000.) On west bank of St. Joseph river, which furnishes fine water-power. Manufactures agricultural implements, sewing machines and wagons. Laid out in '31. Has sewers and electric lights.

History.—Built in '73 by town. Engr., H. P. M. Birkinbine. In '79 and '84 works were improved. Engr. in '79, E. L. Abbott.

Water Supply.—Artesian wells, pumping from receiving reservoir to stand-pipe. Eleven 4-in. wells, located in and around reservoir and near river; av. depth, 120 ft. Water formerly taken from river.

Dam.—Owned by So. Bend Hydraulic Co.; timber, brush and stone, about 250 ft. long. Diverts water for power to underground flume, leading to pumps.

Receiving Reservoir.—Cap., about 500,000 galls.; in excavation, close by river, 80 x 53 ft., x 18 ft. deep; walls of brick, banded with iron, carried up 2 ft. above ground.

Conduit.—A 20-in. pipe from reservoir to pumps.

Pumping Machinery.—Dy. cap., 6,000,000 galls.; Deane; 3,000,000, steam, 3,000,000 water-power. At first there were three Flanders driven by turbine water-wheel. Deane pumps and a new pump house were added in '80. *Boilers:* 208-H. P., Babcock & Wilcox; placed in '89. In '90 it has been proposed to add another engine to drive remaining water-power pump; low water in summer compels almost exclusive use of steam then.

Stand-Pipe.—Plate iron, 5 x 204 ft., enclosed in brick tower.

Distribution.—*Mains*, 25 miles; Wyckoff wood, 13, c. i., 12 miles. *Services*, lead. Iron pipe and specials from Crane Bros., Chicago, Ill., Dennis Long & Co., Louisville, Ky., and Lake Shore Foundry, Cleveland, O. Trenching and pipe-laying done by city. *Taps*, 1,435. *Meters*, Worthington, Thompson, 85. *Hydrants*, Mathews, Flower, 305. *Valves*, Flower.

Consumption, 1,750,000 galls. *Pressure:* Ordinary, 75 lbs. Fire, 95 lbs.

Financial.—Cost, $250,000. Debt, $178,000: $63,000 at 5½, $115,000 at 5%. Sinking fund, $14,675. Ann. op. exp., $6,000. Ann. rev.: consumers, $12,000; city, by taxes, $9,000.

Management.—Trustees, Prest., Alex. Staples. Supt., Ira S. Schrof.

TERRE HAUTE, *Vigo Co.* (Pop., 26,042; est., 40,000.) On east bank of Wabash river, on high, level plateau about 50 ft. above low water. Has extensive manufactories. Incorp. Has sewers and electric lights.

History.—Built in '73 by Terre Haute Water-Works Co. Purchased in '89 by syndicate, represented by Jas. Gamble, N. Y. City; about $750,000 worth of improvements projected for '89-90.

Water Supply.—Wabash river, filtered, by direct pumping.

Filter Bed.—Built so water would pass over it in going to receiving wells. As river rises 20 to 27 ft. above low water, beds are often submerged and have not proved successful.

Filter.—Dy. cap., 3,000,000 galls.; National.

Receiving Wells.—Two, each 12 ft sq. x 8 ft. deep, and connected with pumps by suction pipes 24 ft. long.

Pumping Machinery.—Dy. cap., 10,000,000 galls. Two sets of condensing beam engines, each having two 20 x 36-in. cylinders, 9 x 36-in. pump to each cylinder; from Clapp & Sons, Hudson, N. Y.

Distribution.—*Mains*, c. i., 26 miles. *Services*, lead. *Taps*, 900. *Meters*, 3. *Hydrants*, Mathews, 479. *Valves*, Ludlow.

Consumption, 2,000,000 galls. *Pressure:* Ordinary, 35 lbs. Fire, 100 lbs.

Financial.—Cost., $380,000. Cap. stock, $220,000. Bonded debt, $100,000. Int., 8%. Ann. op. exp., $5,000. Ann. rev.: consumers, $35,000; city, $18,000. Hydrant rental, $40.

Management—(May, '89, before purchase by syndicate). Prest., C. Fairbanks. Secy., J. W. Cruft. Treas., D. Deming. Supt., L. L. Williamson. Address, Jas. Gamble, 68 Wall St., N. Y. City.

UNION CITY, *Randolph Co.* (Pop., 2,478; est., 6,000.) Engaged in manufacturing. Has sewers and electric lights.

History.—Built in '73 by town. Const. Engrs., Snyder & Williams, Dayton, O.

Water Supply.—Surface well, by direct pumping.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; two Deane, double-acting, 14 x 16-in.; erected in '73. *Boilers:* 42-H. P., tubular, Root, 80-H. P., tubular.

Distribution.—*Mains*, Wyckoff wood, c. i., 6 miles. *Services*, not given. *Taps*, withheld, est., 200. *Meters*, 24. *Hydrants*, kind not given, 93.

Consumption, 194,891 galls. *Pressure:* Ordinary, 40 lbs. Fire, 80 lbs.

Financial.—Cost, $60,000. Debt, withheld. Int., 8%. Sinking fund, "half-mill on dollar." Ann. op. exp., $3,192. Ann. rev.: consumers, $2,958.

Management.—Water Board of three. Secy., I. G. Stall. Supt., E. G. Pettis.

VALPARAISO, *Porter Co.* (Pop., 4,461; est., 7,000.) Manufactures wagons, violins, iron and brass goods. Sewers contemplated in '89. Has electric lights.

History.—Built in '85-6 by Valparaiso City Water Co. Const. Engrs. and Contrs., Michigan Pipe Co., Bay City; A. L. Holmes, Grand Rapids, Mich.

Water Supply.—Flint lakes, 3 m. sq. x 50 ft. deep, by direct pumping.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; 1,500,000 Gaskill horizontal. *Boilers:* two, steel.

Distribution.—*Mains*, Wyckoff wood, 12½ miles *Services*, lead. Pipe from Michigan Pipe Co., Bay City, Mich.; trenching and pipe-laying done by A. L. Holmes. *Taps*, 304. *Meters*, 39. *Hydrants*, Holly, 55. *Valves*, Flower, Galvin.

Consumption, 400,000 galls. *Pressure:* Ordinary, 25 lbs. Fire, 55 lbs.

Financial.—Cost, $100,000. Cap. stock, $45,000. Bonded debt, $55,000. Int., 6%. Ann. op. exp., $5,500. Ann. rev.: consumers, $8,000; city, $4,250. Hydrant rental, $80 for first 50, and $50 for additional.

Management.—Prest., S. V. Saleno, Bay City. Secy. and Treas., H. B. Smith. Supt., Don A. Salyer.

VINCENNES, *Knox Co.* (Pop., 7,680; est., 15,000.) On Wabash river. Manufactures paper, lumber, stoves and woodenware. Incorp. No sewers. Has electric lights.

History.—Built in '85 by Vincennes Water Supply Co., under 20-years franchise. Engr., E. F. Fuller. Contrs., Saml. R. Bullock's Co. Both of N. Y. City.

Water Supply.—Wabash river, pumping to stand-pipe. In time of high water supply is taken from two large filtering wells sunk in gravel near river.

Suction Pipe.—Diam., 20 ins.

Pumping Machinery.—Dy. cap., 4,000,000 galls.; two Deane, comp., cond. *Boilers:* three, 5 x 18-ft., tubular.

Force Main.—Diam., 20 ins.

Stand-Pipe.—Cap., 568,000 galls.; 22 x 200 ft.; from Tippett & Wood, Phillipsburgh, N. J. Said to have novel system of inside bracing.

Distribution.—*Mains*, c. i., 15 miles. *Services*, w. i., lead. Pipe and specials from Dennis Long & Co., Louisville, Ky. *Taps*, 356. *Meters*, 8. *Hydrants*, Ludow, 150. *Valves*, Ludlow.

Consumption and *Pressure*, not given.

Financial.—Cost, $375,000. Cap. stock, $200,000. Bonded debt, $175,000. Int., 6%. Ann. op. exp. (in '87), $3,850. Ann. rev.: consumers (in '87), $9,640; city, $5,000. Hydrant rental, $33.33.

Management.—Prest., H. G. Hopper. Secy. and Treas., Walter Wood, Philadelphia. Supt., Wm. B. Chadwick. Gen. Supt., A. W. McCullum, 400 Chestnut St., Philadelphia.

WABASH, *Wabash Co.* (Pop., 3,800; est., 10,000.) On Wabash river. Has various manufactories. Incorp. No sewers. Has electric lights.

History.—Built in '86-7 by Wabash Water Co., under 20-years franchise. Engr. C. Delafield. Contrs., Saml. R. Bullock's Co. Both of N. Y. City.

Water Supply.—Treaty creek, springs, and driven well, pumping to stand-pipe from impounding reservoir. Well sunk in '89; 10 ins. in diam., 82 ft. deep; est. dy. flow, 2,000,000 galls.

Reservoir.—No data.

Pumping Machinery.—Dy cap., 3,000,000 galls.; two 1,500,000 Gaskill, dup., comp., cond.

Stand-Pipe.—Is 25 x 100 ft.; from Tippett & Wood, Phillipsburgh, N. J.

Distribution.—*Mains*, c. i., 12 miles. *Services*, w. i., lead. Pipe and specials from Dennis Long & Co., Louisville, Ky. *Taps*, 400. *Meters*, none. *Hydrants*, Ludlow, 129. *Valves*, Ludlow.

Consumption, 250,000 galls. *Pressure:* Ordinary, 75 lbs. Fire, 150 lbs.

Financial.—Cost (in '87), $175,000. Cap., stock, $150,000. Bonded debt (in '87), $130,000. Int., 6%. Ann. op. exp, $3,000. Ann. rev.: consumers, $5,000; city, $5,000 Hydrant rental, $45.

Management.—Treas., Chas. E. Kimball, 34 Pine St., N. Y. City. Supt., N. S. Stitt.

WARSAW, *Kosciusko Co.* (Pop., 3,123; est., 4,000.) On Tippecanoe river. Engaged in lumbering and manufacturing. Incorp. No sewers. Has electric lights.

History.—Built in '86 by Warsaw Water-Works Co., under 20-years franchise Chf. Engr., S. H. Lockett, N. Y. City. Asst. Engr., Jno. M. Walker, Lawrence Kan. Contrs., Comegys & Lewis, N. Y. City. Electric lights run in connection with water-works. In '89 or '90 the Indiana Water and Light Co. was organized to operate these works; see same under Shelbyville.

Water Supply.—Infiltration well and Center lake, pumping to stand-pipe and direct. Well is near lake, is 25 ft. diam. and has 18 ft. of water Lake covers 80 acres and has clear, large stream flowing from it. Brick pump-house is 250 ft. from lake.

Pumping Machinery.—Dy. cap., 2,000,0000 galls.; two 1,000,000 Worthington, comp., dup. *Boilers:* two, 5x16-ft.; from Sinker, Davis & Co., Indianapolis.

Stand-Pipe.—Is 5x125 ft.; from Tippett & Wood, Phillipsburgh, N. J.

Distribution.—(Jan. 1, '90.) *Mains*, iron, 5½ miles. *Services*, lead, iron. *Taps*, 300. *Meters*, none. *Hydrants*, Mathews, 52.

Consumption (in '87), 300,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 80 lbs.

Financial.—(Jan. 1, '90.) Cost, $95,000. Debt, see Indiana Water and Light Co., under Shelbyville. Ann. op. exp., $2,000. Ann. rev.: consumers, $4,400; city, $3,500. Hydrant rental, $50.

Management.—Supt., W. H. Eggleston.

WASHINGTON, *Daviess Co.* (Pop., 4,323.) Is 20 miles east of Vincennes. Engaged in mining and manufacturing. Incorp. No sewers.

History.—Built in '88 by Washington Water-Works Co., controlled by Moffett, Hodgkins & Clarke, Syracuse, N. Y., Contrs. Supt. of Const., Clark Kellogg. Put in operation Dec. 15, '88.

Water Supply.—White river, pumping to stand-pipe and direct.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two Gaskill, comp. and high-pressure. *Boilers:* from Erie City (Pa.) Iron Works.

Stand-Pipe.—Steel, 20x100 ft., from Sharon (Pa.) Boiler Works.

Distribution.—*Mains*, 12 to 4-in. c. i., 7½ miles; from Lake Shore Foundry Co., Cleveland, O.; laid by C. E. Gray, Jr., Chicago. *Services*, not given. *Taps*, 96. *Meters*, 10. *Hydrants*, Ludlow, 90. *Valves*, Ludlow.

Consumption, 141,325 galls. *Pressure:* 50 to 150 lbs.

Financial.—Cost, $130,000; cap. stock, $100,000. Debt, $115,000. Int., 6%. Ann. op. exp, $2,000. Ann. rev.: (in '89, est.) consumers, $6,400; city, $3,000. Hydrant rental, about $30.

Management.—Prest., H. C. Hodgkins, Syracuse, N. Y. Supt., R. B. Boyce.

WOLCOTTVILLE, *Lagrange Co.* (Pop., est., 500.)

General Description.—Built in '89 by Wolcottville Water-Works Co., for fire protection. Supply, mill-race, pumping by means of hydraulic ram to tank. Mains on principal street. Cost, $700. Prest., C. R. Moon. Secy. and Supt., O. L. Hall. Treas., Louis Welt. Latest report, Jan. 6, '90.

Water-Works Projected with Fair Prospects of Construction.

AVILLA, *Noble Co.* (Pop., 466; est., 900.)

Proposed Works.—Will be small if built. Address C. A. Schneider.

DANVILLE, *Hendricks Co.* (Pop., 1,598; est., 2,500.)

Proposed Works.—Natural Gas Co. to build if town will contract for hydrants. Supply, artesian well, pumping to stand-pipe. Est. cost, $30,000 to $50,000. Prest., Jas. O. Parker. Secy., J. A. Downard. Report, about Mar. 1, '90.

HUNTINGBURGH, *Dubois Co.* (Pop., 781; est., 3,500.) Engaged in manufacturing and coal mining. Incorp. city.

Proposed Works.—City may build in '90. Supply, Patoka creek. Est. cost, $30,000. Address E. R. Brundick or Jas. Murray. Co.'s project outlined in MANUAL for '88, p. 340, abandoned, as construction was not started within specified time, and city annulled franchise. Date report, Jan. 7, '90.

HUNTINGTON, *Huntington Co.* (Pop., 3,863; est., 9,000.) On Wabash river. Has manufactories and electric lights.

Proposed Works.—Co. to build. Supply, water-bearing gravel, pumping to stand-pipe. Est. cost, $125,000 to $150,000. Proposals were to be received till Feb. 10, '90, for two 1,500,000-gall. pumps, stand-pipe 25 x 125 ft., 16.6 miles 16 to 6-in. mains, 150, hydrants. Chn. Com., Jacob Speaker. City Clerk, Jos. M. Black. Date report, Jan. 25, '90.

MARTINSVILLE, *Morgan Co.* (Pop., 1,943; est., 4,000.) On White river 30 miles from Indianapolis. Has manufactories and electric lights.

Proposed Works.—Mar. 25, '90, City Council were investigating, and seemed in favor of city ownership. Chicago Co. had made proposition, but council was opposed to giving the 30-years franchise desired. Supply, springs near and above city and White river. Chn., M. Bales.

PRINCETON, *Gibson Co.* (Pop., 2,566; est., 3,700.)

Proposed Works.—Co. to build in '90; not organized. Supply, wells, pumping to stand-pipe. Est. cost, $15,000 to $25,000. Mayor, Jas. B. Gumble, Report, Jan. 13, '90.

WATERLOO, *De Kalb Co.* (Pop., 1,376; est., 2,000.) On Cedar creek.

Proposed Works.—Village to build. Supply, pumping to tank or reservoir. Est. cost, $1,500. Address Eli Williamson or J. F. Shinnan. Report, Jan. 6, '90.

Water-Works Projects Reported in '89 and '90, but Now Indefinite.

Arcola, Allen Co. *Broad Ripple*, Marion Co. *Covington*, Fountain Co. *Denver*, Miami Co. *Edinburgh*, Johnson Co. *Fairland*, Shelby Co. *Franklin*, Johnson Co. *Greenfield*, Hancock Co. *Monticello*, White Co.

MICHIGAN.

Water-Works Completed or in Process of Construction.

ADRIAN, *Lenawee Co.* (Pop., 7,849; est., 10,000.) On south branch of Raisin river. Engaged in manufacturing. Settled in '28; incorp. village in '38, city in '53 Has electric lights.

History.—Built in '83-4 by Adrian Water-Works Co., under 30-years franchise. Consult. Engr., Peter Hogan, Albany, N. Y. Contrs., Holly Mfg. Co., Lockport, N. Y.

Water Supply.—Surface and artesian wells, by direct pumping. Surface well is 24.6 ft. diam., 23 ft. deep.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two 1,500,000 Gaskill, horizontal. *Boilers:* 5x16 ft.

Distribution.—*Mains*, c. i., 15 miles. *Services*, galv. i., lead. *Taps*, 400. *Meters*, 5. *Hydrants*, Holly, 120. *Valves*, Ludlow.

Consumption, 450,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 90 lbs.

Financial.—Cost, withheld, est., $150,000. Bonded debt, $145,000. Int., 7%. Ann. op. exp., $4,500. Ann. rev.: consumers, $1,000; city, $10,000. Hydrant rental, $83.33 for first 120, and $75 for each additional.

Management.—Prest., S. L. Wiley, Omaha, Neb. Secy., K. N. Wiley. Supt., A. F. Haas.

NOTE.—Data about the same as for '88, Supt. Haas reporting "cannot give any information different from what is in MANUAL for '88."

ALBION, *Calhoun Co.* (Pop., 2,716; est., 2,300.) On Kalamazoo river, 20 miles from Jackson. Has manufactories and electric lights.

General Description.—Built in '89 by city. Unofficially reported about middle of '89 that contract had been let to T. C. Brooks, Jackson, for $36,800; that engines and stand-pipe would be furnished by Lansing Iron & Engine Works; also that $50,000 of 5% bonds had been sold at 105.

ALLEGAN, *Allegan Co.* (Pop., 2,305; est., 3,000.) In valley on Kalamazoo river, which affords good water-power at this point. Engaged in lumbering and manufacturing. Settled in '33; incorp. village in '37. No sewers. Has electric lights.

History.—Built in '71 by village. Engr., —— Phelps, Kalamazoo.

Water Supply.—Well, 24 ft. diam., on bank of Kalamazoo river, by direct pumping.

Dam.—Stone and earth, 8 ft. high. Built across river to furnish water-power for pumping.

Pumping Machinery.—Dy. cap., 1,125,000 galls.; Walker, water-power. When works were built two 500,000 Holly rotary pumps were driven by turbine water-wheel.

Distribution.—*Mains*, c. i., 5 miles. *Services*, w. i. *Taps*, 225. *Meters*, none. *Hydrants*, Holly, Galvin, Ludlow, Flower, 40. *Valves*, Ludlow, Galvin.

Consumption, 300,000 galls. *Pressure:* Ordinary, 45 lbs. Fire, 100 lbs.

Financial.—Cost, $45,000. No debt. Ann. op. exp., $1,400. Ann. rev.: consumers, $2,000.

Management.—Prest., H. Hart. Supt., M. Deyer.

ALMA, *Gratiot Co.* (Pop., 925; est., 1,500.) On Pine river. Engaged in manufacturing and lumbering. Settled in '54; incorp. village in '73.

History.—Built in '82 by village. Des. Engr. and Contr. for all but buildings, M. Walker, Fenton, Mich.

Water Supply.—Pine river, by direct pumping.

Pumping Machinery.—Dy. cap., 1,750,000 galls.; two 500,000 Walker water-power, 8 x 12-in., and 750,000 Smith & Vaile, steam.

Distribution.—*Mains*, Wyckoff wood, 4 miles; from Mich. Pipe Co., Bay City. *Services*, w. i. *Taps*, 50. *Meters*, none. *Hydrants*, Holly, 35. *Gates*, Galvin.

Consumption, not given. *Pressure:* Ordinary, 30 lbs. Fire, 90 lbs.

Financial.—Cost, $15,000. Debt, $8,000. Int., 6%. Ann. op. exp., $1,000. Ann. rev., not given, est., $1,000.

Management.—Supt., J. M. Montegel, Jr.

NOTE.—Above same as in '88 MANUAL, Supt. reporting "description all right."

ALPENA, *Alpena Co.* (Pop., 6,153; est., 10,000.) On Thunder bay, Lake Huron, at mouth of Thunder river. Has large lumber industries. Incorp. city in '71. Has sewers and electric lights.

History.—Built in '79 by Alpena City Water Co. Engrs. and Contrs., Mich. Pipe Co., Bay City. Contr. for extensions, A. L. Holmes, Grand Rapids.

Water Supply.—Thunder bay and river by direct pumping. Pump-well on shore of bay is connected with crib in lake and pond on river.

Intake Crib.—Of timber, bolted together and filled with stone; in 16 ft. of water 1¾ miles from shore.

Intake Pipe.—Wyckoff wood, 24-in. Air-pump has been attached to intake pipe.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; 4 Walker and Holly rotary. *Boiler:* tubular. *Water-wheels:* two Leffel turbines, 87½ and 50-in. in diam., driving Holly pumps. Formerly there was a Dixon dup., of 9x18 ins.

Distribution.—*Mains*, Wyckoff wood, 17½ miles. *Services*, lead. *Taps*, 1,264. *Meters*, none. *Hydrants*, Holly-Gaskill, 113.

Consumption, 1,500,000 galls. *Pressure:* Ordinary, 33 lbs. Fire, 80 lbs.

Financial.—Cost, $200,000. Debt, $47,500. Int., 7%. Ann. op. exp., $5,000. Ann. rev.: consumers, $7,250; city, $9,000. Hydrant rental, about $60.

Management.—Prest. and Supt., W. H. Johnson. Secy., F. W. Gitchink. Treas., A. W. Comstock.

ANN ARBOR, *Washtenaw Co.* (Pop., 8,061; est., 10,000.) On Huron river. Has several manufactories. Incorp. No sewers. Has electric lights.

History.—Built in '85-6 by Ann Arbor Water Co., under 30-years franchise. Engr,, Prof. Chas. E. Greene, Ann Arbor. Contrs., Goodhue & Birnie, Springfield, Mass.

Water Supply.—Springs and surface water, pumping to reservoir.

Pumping Machinery.—Dy. cap., 4,000,000 galls.; 1,000,000 Knowles, 2,000,000 Gordon, added in '89.

Reservoir.—Cap., 9,000,000 galls.; 175 ft. above city.

Distribution.—*Mains*, c. i., 20½ miles. *Services*, galv. i. *Taps*, 1,000. *Meters*, 2. *Hydrants*, Pattee & Perkins, 112.

Consumption, 500,000 galls. *Pressure:* Ordinary, 65 lbs. Fire, 100 lbs.

Financial.—Cost, $215,000. Cap. stock, $50,000. Bonded debt, $150,000. Int., 6%. Ann. op. exp., $3,334. Ann. rev.: consumers, $10,023; city, $4,775. Hydrant rental, $45 for 100, and $40 for additional.

Management.—Prest. and Supt., Alex. W. Hamilton. Secy., C. E. Hiscock. Treas., S. K. Hale.

AU SABLE, *Iosco Co.* (Pop., 1,328; est., 6,000.) Engaged in lumbering and in manufacturing salt and shingles.

History.—Built in '85 by town. Des. Engr., M. K. Walker, Fenton. Const. Engr. and Contr., for pipe-laying, A. L. Holmes, Grand Haven. All other labor by village. Suction pipe may be extended into lake, or well dug for better supply.

Water Supply.—Au Sable river, by direct pumping. Water is not fit for culinary purposes.

Pumping Machinery.—Dy. cap., 1,440,000 galls.; two Walker.

Distribution.—(Mar. 5, '90.) *Mains*. Wyckoff wood, 6 miles; from Mich. Pipe Co., Bay City. *Services*, ¾-in. w. i. *Taps*, 200. *Meters*, none. *Hydrants*, Holly-Gaskill, 58.

Consumption, 500,000 galls. *Pressure:* Ordinary, 35 lbs. Fire, 90 to 100 lbs.

Financial.—(Mar. 5, '90.) Cost, $25,000. Debt, $7,000. Int., 7%. Ann. op. exp., $1,700. Ann. rev.: consumers, $800.

Management.—Supt., J. S. Duncan.

BATTLE CREEK, *Calhoun Co.* (Pop., 7,063; est., 15,000.) At junction of Battle creek with Kalamazoo river. Has good water-power, and manufactures boilers, woolen goods, paper, printing presses and threshing machines. Incorp. Sewers projected in '89. Has electric lights.

History.—Built in '87 by city. Des. Engrs. and Contrs., MacRitchie & Nichol, Chicago, Ill., with W. W. Brigden, Const. Engr.

Water Supply.—Goguac lake, pumping to stand-pipe. Area of lake, 360 acres; ax. depth, 72 ft.; 80 ft. above, 2 miles from business part of town.

Inlet Pipe.—Diam., 16 ins.; length, 591 ft.; laid in trench dredged in lake to deep water, then supported on piles to where water is 25 ft. deep. Movable length, worked by strong crab from platform, enables outer, screened, end of pipe to be cleaned and water taken from any desired depth.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two 1,500,000 Blake comp., dup., *Boilers:* two, tubular, 5 x 16 ft.; from Eagle Iron Works, Detroit.

Stand-Pipe.—Cap., 143,000 galls.; 18 x 75 ft.; from Eagle Iron Works, Detroit.

Distribution.—*Mains*, 16 to 4-in. c. i., 15 miles. *Services*, lead to 1-in., galv. i. above 1-in. Pipe and specials from Dennis Long & Co., Louisville, Ky.; trenching and pipe-laying done by M. Philbin, Chicago. *Taps*, 528. *Meters*, Crown, 22. *Hydrants*, Mathews, 135. *Valves*, Eddy.

Consumption, 230,000 galls. *Pressure*, 70 to 90 lbs.

Financial.—Cost, $138,315. Bonded debt, $100,000. Int., 4½%. Ann op. exp., $4,168. Ann rev.: consumers, $5,959.

Management.—Board of Public Works. Secy., W. C. Gage. Supt., W. W. Brigden.

BAY CITY, *Bay Co.* (Pop., 20,693; est., 33,000.) On Saginaw river, about 4 miles from its mouth, having river frontage of about 7 miles, and extending back on plain 10 to 20 ft. above river. Soil is heavy, impervious clay, extending 100 ft. to rock. Has extensive lumber and salt industries. Incorp. Has sewers and electric lights.

History.—Built in '72 by city, when pop. was about 10,000. Previous to this supply had been entirely from wells and cisterns. Preliminary plans were made by

Geo. C. Morgan, Chicago, Ill., after which E. L. Dunbar was Engr., with Geo. D. Wolcott, Jackson, Mich.; Consult. Engr.

Water Supply.—Saginaw bay, arm of Lake Huron, by gravity to pumps, thence by direct pumping. Auxiliary supply for fire protection can be taken from river. In '88 this was necessary 32 times, but aggregate of pumping from river was but 44 hours. Bay is shallow, being but 8 ft. deep a mile from shore, and 16 at three miles. Very heavy and long continued southwest gale reduces depth of water 4 ft., sometimes for several hours. Water is quite hard and in summer frequently becomes turbid from action of the waves on bottom of bay, and on unprotected inner banks of inlet channel and basin. Latter is 4 miles from mouth of river, and supply seems free from contamination with sewage discharged by stream.

Intake Basin.—To secure constant supply and protect intake pipe from ice, basin was constructed 1,500 ft. from shore; 150 x 300 ft. long, x 10 ft. deep, the earth from excavation forming bank around it. Water is admitted to basin by open dredged channel extending to 8 ft. of water, banks of both basin and channel being protected on outer side by sheet piling. At junction of channel and basin, water passes through timber crib filled with coarse gravel.

Intake Conduit.—Diam, 30 ins.; length, 21,186 ft., 7 ft. under water at bay, 4 ft. fall to pumps, which are within city limits. Of pine staves, 3 ins. thick, from 4 to 6 ins. wide, dressed and jointed to circular form. In 8-ft. sections, with socket joints 3 ins. deep, formed by turning off half thickness of one end and boring out adjoining end to fit. Elm bands 3 ins. wide and ¼ in. thick pass twice around the conduit every 2 ft., and are secured with galv. i. nails. Most of conduit was laid without difficulty in heavy clay soil, but 2,500 of it is through quicksand, and has settled below grade, allowing sand to enter and slightly impede flow. Original cap., 5,500,000 galls., which in '81 had been reduced to a little less than 5,000,000.

Pumping Machinery.—Dy. cap., 9,500,000 galls.; 5,000,000 Gaskill horizontal, 2,000,000 Holly quadruplex comp., cond., crank and fly-wheel; horizontal high-pressure piston engine driving two Holly rotary. *Boilers:* 3 return tubular boilers, each 5½ x 16 ft.; total grate surface, 61½ ft.

Distribution.—*Mains*, 20 to 3-in. Wyckoff wood, c. i., 27⅞ miles. *Services*, lead, w. i., Wyckoff wood. *Taps*, 1,389. *Meters*, Crown, Empire, Union rotary and duplex, Worthington, 215. *Hydrants*, Holly, Mathews, Gaskill, Galvin, 215. *Valves*, Flower, Galvin. *Close of* '80: Mains, 19¼ miles. Taps, 821. Meters, none. Hydrants, 138.

Consumption. 2,385,219 galls. *Pressure:* Ordinary, 40 lbs. Fire, 80 lbs.

Financial.—Cost, $440,078. Debt, $375,000: $357,000 at 8, $18,000 at 4%. Sinking fund, none. Ann. op. exp., $10,249. Ann rev.: consumers, $21,332; city, interest on debt, paid by taxation.

To Dec. 1, '80: cost, $365,659; total maintenance and operation, not including int. on debt, $70,366; total rev., $74,073. Rev. for '80, $13,603.

Management.—Seven Comrs. Prest., A. Walton Chf. Engr., Supt. and Secy., E. L. Dunbar.

BELLAIRE, *Antrim Co.* (Pop., est., 600.) On Intermediate river. Manufactures woodenware. Partially sewered. No electric lights.

History.—Built in '83 by Robt. Rickardi, and owned by him.

Water Supply.—Cedar river, pumping to reservoir.

Pumping Machinery.—Dy. cap., 100,000 galls.; Knowles, water-power.

Reservoir.—Cap., 200,000 galls.; 60 ft. in diam., 10 ft. deep; elevation, 200 ft.

Distribution.—*Mains*, 6-in. wood, 4-in. iron, 3 miles. *Services*, not given. *Taps*, 70. *Meters*, none. *Hydrants*, Galvin, 8.

Consumption, 60,000 galls. *Pressure*, 78 lbs.

Financial.—Cost, $5,500. No debt or stock. Ann. op. exp., $150. Ann. rev.: consumers, $300; city, about $300. Hydrant rental, "paid by citizens, .08% on perishable property." [Probably a percentage on valuation of property that could be destroyed by fire.—Ed.]

Management.—Owner, Robt. Rickardi.

BESSEMER, *Gogebic Co.* (Pop., est., 5,000.) In iron, mining and lumbering section Incorp. village. No sewers. Has electric lights.

History.—Built in '87-8 under 30-years franchise, by Gogebic Water & Gas Supply Co. Engr., G. E. Beach.

Water Supply.—Springs and wells, by direct pumping from collecting reservoir.

Reservoir.—Cap., est., 100,000 galls.; 30 x 30 ft.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Worthington dup. *Boiler:* from M. W. Glenn, Minneapolis, Minn.

Distribution.—*Mains*, lap-welded w. i., 2 miles. *Services*, galv. i. Pipe and specials from National Pipe & Foundry Co., Scottdale, Pa. *Taps*, not given, est., 50. *Meters*, number not given, Worthington. *Hydrants*, Ludlow, 24. *Valves*, Ludlow.

Consumption, not determined. *Pressure:* Ordinary, 60 lbs. Fire, 100 lbs.

Financial.—Cost, $50,000. Debt, $40,000. Int., 6%. Ann. op. exp. and rev., not determined. Hydrant rental, $100.

Management.—Prest., G. E. Beach, Minneapolis, Minn. Secy., W. C. Deverest, White Bear, Minn. Treas., E. E. Cooley, Minneapolis, Minn.

BIG RAPIDS, *Mecosta Co.* (Pop., 3,552; est., 7,000.) On Muskegon river on nearly level ground, greatest difference in elevation being 35 ft. Has good water-power used in manufacturing. Settled in '60. Incorp. Has sewers and electric lights.

History.—Built in '71 by town; improved in '85, changing source of supply. First works designed by Water Board. Const. Engr., W. R. Coats, Kalamazoo.

Water Supply.—Driven wells, by direct pumping from collecting reservoir. First supply was from Muskegon river, by direct pumping from gravel filter crib.

Reservoir.—Cap., about 30,000 galls.

Pumping Machinery.—Dy. cap., 3,500,000 galls.; Holly dup., two 1,500,000 Gaskill water-power. Formerly two Blake.

Distribution.—(In '87.) *Mains*, c. i., 10 miles. Wooden mains were used, but proved unsatisfactory. *Services*, lead. *Taps* (in '82), 209. *Meters*, none. *Hydrants*, Ludlow, 84. *Valves*, Ludlow.

Consumption, 2,000,000 galls. *Pressure:* Ordinary, 65 lbs. Fire, 100 lbs.

Financial.—Cost, $95,000 Bonded debt, $35,000 Int., 4½%. Ann. op. exp., $1,300. Ann. rev.: consumers, $3,000.

Management.—Common Council. Secy., W. H. Clark. Supt., Wm Jefts.

CADILLAC, *Wexford Co.* (Pop., 2,213; est., 6,000.) Manufactures machinery, and has lumber trade. Incorp. Has sewers and electric lights.

History.—Built in '78 by Co., name withheld. Engr., H. H. Greene, Cadillac. Contr. for masonry, E. George & Co.; for buildings, J. G. Mosser.

Water Supply.—Clam lake, by direct pumping.

Pumping Machinery.—Dy. cap., 5,000,000 galls.; 2,000,000 Gaskill comp., dup., 3,000,000 Davidson.

Distribution.—*Mains*, Wyckoff wood, 5½ miles. Pipe from Michigan Pipe Co., Bay City; laid by H. H. Greene. *Services*, lead. *Taps*, 500. *Meters*, none. *Hydrants*, Holly, 45. *Valves*, Galvin.

Consumption, about 1,000,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 110 lbs.

Financial.—Cost, $35,000. Debt, none. Ann. op. exp. (in '87), $3,000. Ann. rev.: consumers, $9,500; city, $3,250. Hydrant rental, $50.

Management.—Engr., H. H. Greene.

CAPAC, *St. Clair Co.* (Pop., est., 500.) Incorp. No sewers or electric lights.

History.—Built in '87-8 by village, under direction of Trustees. No Engr. For fire-protection and street-sprinkling only. **Water Supply.**—Tubular well sunk to and into rock, pumping to tank. **Pumping Machinery.**—Dy. cap., not given; windmill. **Tank.**—Cap., about 15,000 galls.; Contr., G. Leister. **Distribution.**—*Mains*, kind not given, 1,100 ft. *Taps*, 4. *Meters*, none. *Hydrants*, kind not given, 3. *Pressure*, not given. **Financial.**—Cost, $1,100. No debt. No rev. **Management.**—Trustees. Prest., D. Walker. Secy., Jas. Barber.

CARO, *Tuscola Co.* (Pop., 1,282; est., 1,800.) On Cass river, 30 miles from East Saginaw. Incorp. No sewers. Has electric lights.

History.—Built in '88 by Caro Water Co. Des. Engr., E. A. Abbott. Const. Engr. and Contr., Geo. W. Phelps.

Water Supply.—Springs, pumping to stand-pipe and direct.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Deane

Stand-Pipe.—Cap., about 230,000 galls.; 25x75 ft., on ground 85 ft. above Main St. Contrs., Riter & Conley, Pittsburgh, Pa.

Distribution.—*Mains*, c. i., 3½ miles. *Services*, galv. i. Pipe and specials from Detroit (Mich.) Pipe Co. *Taps*, 125. *Meters*, 11. *Hydrants*, Mathews, 30. *Valves*, Eddy.

Consumption, 40,000 galls. *Pressure:* Ordinary, 60 lbs. Fire 80 lbs.

Financial.—Cost, $40,000. Cap. stock, $25,000. Bonded debt, $30,000. Int., 6%. Ann. op. exp., $1,500. Ann. rev.: consumers, withheld, est., $2,500; city, $1,500. Hydrant rental, $50.

Management.—Prest., Geo. W. Phelps. Secy. and Supt., C. O. Thomas. Treas., A. E. Carrier.

CARSON CITY, *Montcalm Co.* (Pop., est., 1,200.) On Fish creek. Engaged in lumbering. Incorp. No sewers or electric lights.

History.—Built in '88 by village. Des. Engr., S. V. Saleno, Bay City. Const. Engrs. and Contrs., Michigan Pipe Co., Bay City; A. L. Holmes, Grand Rapids.

Water Supply.—Fish creek, pumping to tank, and direct in case of fire

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Smith & Vaile.

Tank.—Cap., about 50,000 galls.

Distribution.—*Mains*, Wyckoff wood, ¾ miles; from Contrs. *Taps*, 10. *Hydrants*, 20.

Consumption and *Pressure*, not given.

Financial.—Cost, $1,103. Bonded debt, $13,000. Ann. op. exp. and rev., not determined. Int., 6%.

Management.—Prest., T. T. Dixon. Secy., S. J. Smith. Supt., Geo. A. Thayer.

CEDAR SPRINGS, *Kent Co.* (Pop., 1,141; est., 1,200.) Engaged in lumbering. Incorp. village. No sewers or electric lights.

History.—Built in '89 by village; put in operation Aug. 17. Engrs. and Contrs., Mich. Pipe Co., Bay City, A. L. Holmes, Grand Rapids.

Water Supply.—Well and creek, direct pumping.

Pumping Machinery.—Dy. cap., 750,000 galls.; Smith & Vaile.

Distribution.—*Mains*, 8 to 4-in. Wyckoff, 3,048 ft. *Services*, galv., i. *Meters*, none. *Hydrants*, Galvin, 8.

Pressure: Ordinary, 60 lbs. Fire, 85 lbs.

Financial.—Cost, $4,200. Debt, $5,000 (of bonds issued). Int., 6%. Ann. op. exp. est., $580. Ann. rev.: est., $660.

Management.—Com. Chn., Frank L. Fuller. Recorder, E. C. Shay.

CHARLOTTE, *Eaton Co.* (Pop., 2,910; est., 4,000.) Is 18 miles from Lansing. Incorp. No sewers. Has electric lights.

History.—Built in '86-7 by town. Contr. for all but buildings, M. Walker, Fenton.

Water Supply.—Wells, by direct pumping.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two 750,000 Walker; others not given.

Distribution.—*Mains*, c. i., 9¼ miles. *Services*, w. i. lead. Pipe and specials from Cincinnati & Newport Iron & Pipe Co., Newport, Ky. *Taps*, 438. *Meters*, none. *Hydrants*, Ludlow. *Valves*, Ludlow.

Consumption, 266,666 galls. *Pressure:* Ordinary, 40 lbs. Fire, 80 lbs.

Financial.—Cost, $45,000. Bonded debt, $40,000. Int., 4%. Ann. op. exp., $2,500 Ann. rev.: consumers, $3,000.

Management.—Comrs. Secy., L. C. Holbrook. Supt., G. W. Richardson.

CHASE, *Lake Co.* (Pop. of township, 1,087; of village, est., 800.) On Pere Marquette river. Engaged in lumbering. Incorp. No sewers or electric lights.

History.—Built in '83 by town, after plans by Wm. Yates, Chase.

Water Supply.—Pere Marquette river, direct pumping.

Pumping Machinery.—Dy. cap., unknown; Holly.

Distribution.—*Mains*, Wyckoff wood, 1 mile. *Services*, ¼-in. iron. *Taps*, 20. *Hydrants*, kind not given, 4.

Consumption, not given. *Pressure:* Ordinary, 40 lbs. Fire, 90 lbs.

Financial.—Cost, $11,000. Debt, $1,500. Int., 7%. Ann. op. exp., $500. Ann. rev.: withheld, est., $500.

Management.—Three Comrs. Prest., J. H. Kneville. Secy., J. C. Brace.

CHEBOYGAN, *Cheboygan Co.* (Pop., 2,629; est., 5,000.) On straits of Mackinaw, Lake Huron and Cheboygan river. On generally level ground, which extends some distance back from lake, then rises to elevation of 600 ft. Engaged in lumbering. Settled in '46; incorp. village in 71. Has sewers and electric lights.

History.—Built in '82 by village. Des. Engr., Geo. P. Smith.

Water Supply.—Two artesian wells, by direct pumping. One well is 300 ft. deep, 180 ft. being 7, and 120 ft., 5 ins. in diam.; other is 450 ft. deep, 180 ft. being 10, and 270 ft., 8 ins. in diam. If necessary, water can be drawn from Lake Huron.

Pump-Well.—Is 24 ft. in diam. x 16 ft deep.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two 750,000 Walker; other not given. *Boilers*, two, horizontal tubular.

Distribution.—*Mains*, Wyckoff, wood, kal. i., 4 miles. *Services*, lead. *Taps*, 200. *Meters*, 1. *Hydrants*, Holly, Ludlow, 35.

Consumption, 230,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—Cost, $39,705. Debt, $25,000. Int., 5½%. Ann. op. exp., $3,022. Ann. rev.: consumers, $1,142; tax of '87, paid in '88, $2,355.

Management.—Comrs. Chn., J. W. McDonald. Secy., Geo. M. Conner. Supt., Chas. Adams.

CLARE, *Clare Co*, (Pop. 502; est., 1,200.) Incorp. No sewers or electric lights.

History.—Built in '86 by town. Engr., M. Walker, Port Huron. Contr. for extensions, A. L. Holmes, Grand Rapids.

Water Supply.—Well, 12 ft. diam., 23 ft. deep, by direct pumping.

Pumping Machinery.—Dy. cap., 2,160,000 galls.; two 500,000 Walker; others not given.

Distribution.—*Mains*, Wyckoff wood, 4¼ miles. *Taps*, 75. *Meters*, none. *Hydrants*, kind not given, 12.

Consumption, 260,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 80 to 100 lbs.

Financial.—Cost, $9,000. Bonded debt, $7,000. Int., 6%. Ann. op. exp., $1,200. Ann. rev.: consumers, $700.

Management.—Three Comrs. Prest., J. H. Carpenter. Supt., A. W. McIntyre.

CONSTANTINE, *St. Joseph Co.* (Pop., 1,404; est., 1,800.) On St. Joseph river. Has good water-power, and is engaged in manufacturing. Incorp. No sewers or electric lights.

History.—Built in 78 by town.

Water Supply.—Fawn river, by direct pumping.

Pumping Machinery.—No data.

Distribution.—*Mains*, 10 to 4 in., Wyckoff, 5 miles. *Services*, galv. i. Pipe from Michigan Pipe Co., Bay City. *Taps*, 181. *Meters*, none. *Hydrants*, Holly, 42. *Valves*, Holly.

Consumption, unknown. *Pressure:* Ordinary, 30 lbs. Fire, 60 lbs.

Financial.—Cost, $222,500. Bonded debt, $14,500: $1,500 at 6, $10,000 at 5%. Ann. op. exp., $250. Ann. rev.: consumers, $725.

Management.—Common Council. Recorder, Thos. Harrison.

CRYSTAL FALLS, *Iron Co.* (Pop., est., 1,000.) Incorp. village. No sewers. Electric lights projected in '90.

History.—Built in '89-90 by village; put in operation Jan. 15. Des. Engr., P. W. Keating. Const. Engrs. and Contrs., Keating & Sheehan, Detroit.

Water Supply.—Collecting reservoir and small stream, direct pumping.

Collecting Reservoir.—Cap., 1,500,000 galls.; 150 x 200 ft., x 16 ft. deep.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Buffalo comp., dup. *Boiler:* from Armstrong Bros., Springfield, O.

Distribution.—*Mains*, 8-in. c. i., 1 mile; from Lake Shore Foundry, Cleveland, O. *Services*, galv. i. *Taps*, 10. *Hydrants*, Galvin, 15. *Valves*, Galvin.

Consumption, 150,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 120 lbs.

Financial.—Cost, $20,000. Bonded debt, $18,000. Bonds authorized, $20,000. Int., 6%.

Management.—Clerk, A. Lustfield. Supt., F. Klyerstenber. Reports, about Dec. 15, '89, Jan. 8, '90.

DETROIT, *Wayne Co.* (Pop., 116,340; est., 200,000; part of the increase is due to annexation of adjoining townships.) On west bank of Detroit river, 18 miles from Lake Erie, 7 from Lake St. Clair. Ground rises from river about 58 ft. in a mile. Has good harbor, extensive commerce and manufactories. Settled in 1701 by the French, occupied in 1736 by the British, and in 1787 by U. S. Government. Incorp. Has sewers and electric lights.

History.—First supplied in '27 by Rufus Wells, when pop. was about 1,500. Later Mr. Wells formed the Hydraulic Co., which extended works from time to time. June 4, '36, Co. having expended $23,608 above receipts, city bought works for $20,500.

Various extensions were made thereafter, and since '75 new works have been enlarged from pumping cap. of 30,000,000 to 80,000,000 galls. Old works have been abandoned. Des. Engr. of improvements till close of '77, D. Farrand Henry.

For description of works from '27 to '75 see MANUAL for '88, pp. 316-8.

Water Supply.—Detroit river, pumping to stand-pipe. New supply taken 4 miles above old.

Intake Pipes.—Three, two 5, one 6 ft.; 6-ft. not described. One of the 5-ft. is used only in winter, when troubled with anchor ice; it is near or at surface. Other 5-ft. extends from point 1,100 ft. from shore to settling basin, with outer end on river bottom, in a crib; laid in sections in a dredged trench, being bolted under water.

Settling Basin:—Is 365 x 800 ft., 13 ft. deep at the river, 17 at conduit end. Bottom of solid clay; sides of double rows of sheet-piling, planked, filled between with 14 ft. of puddled clay. Submerged weir, 75 ft. from river end, prevents direct current from inlet to outlet.

Conduit.—Of brick, 5 ft. in. diam. From a well 16 ft. in diam. two branches lead to pump-wells, which are 26 ft. deep.

Pumping Machinery.—Dy. cap., 82,000,000 galls. Since '77 two 26,000,000 and one 30,000,000-gall. pumps have been added. That known as No. 1 was built at Detroit Locomotive Works, and No. 2 at Riverside Iron Works, Detroit. No. 3 re-built from beam engine taken down from old works in '84. *Boilers:* 8 batteries of 4 each.

Stand-Pipe.—Is 132 ft. high, 5 ft. in diam. at base, 2½ at the top; plates decrease from 5/8 to 3-16 in. in thickness.

Distribution.—*Mains*, c. i., wood, 343 miles. Wooden pipe was laid as late as '81, but at a diminishing rate each year, in '80 but 1½ miles being laid, while 2½ miles were replaced with iron pipe. In '81 there were 84¼ miles of 2½ to 4-in. wooden pipe, and of the 124¾ miles of iron pipe then in use, 56 miles were 3 and 4 ins. in diam. *Services*, lead. *Taps*, 31,821. *Meters*, 50; first used in '76. *Hydrants*, Flower, Galvin, Murdock, 1,571; also 312 cisterns. *Valves*, kind, do. *Close of '80*: Mains, 209 miles. Taps, about 20,800, having been 19,736 in '79, 21,976 in '87. Meters, 33. Hydrants, 731; also 173 cisterns.

Consumption, 39,397,716 galls. *Pressure*, 25 lbs.

Financial.—Cost, $4,267,129. Debt, $1,327,000. Int., 4, 6 and 7%; av., 5.28%. Sinking fund, $20,024. Ann. op. exp., $101,019. Ann. int., $83,400. Ann. rev.: consumers "and other sources," $366,472; city, general tax levy, $70,024.

Management.—Comrs. Secy, L. N. Case. Supt., Henry Bridge.

References.—*To Engineering News:* regarding new works, especially pumping machinery, vol., IV., p. 179, and vol. VII., p. 439; whole system, vol. VIII., p. 194.

Tenth Census U. S., vol. XVII., Water Supply of American Cities, pp. 65-9.

DOWAGIAC, *Cass Co.* (Pop., 2,100; est., 3,500.) Engaged in grain and produce trade and general manufacturing. Incorp. city. No sewers. Electric lights projected.

History.—Built in '89 by city; put in operation in Oct. Contrs., Keating & Sheehan, Detroit.

Water Supply.—Artesian wells, direct pumping from receiving reservoir. Five wells, 95 ft. deep, throwing water 12 ft. above surface.

Receiving Reservoir.—Cap., 300,000 galls.; 39 ft. in diam., 16 deep, with double bottom of timber and brick; water tight. An 8-in. valve and discharge-pipe provides for cleaning, and for increased supply in case of fire.

Pumping Machinery.—Dy. cap., not given; Holly. *Boilers:* from Lansing Iron & Engine Works.

Distribution.—*Mains*, 10 to 4 in. c. i., 9 miles. *Meters*, none. *Hydrants*, Mathews, 72 public, 8 private. *Valves*, Galvin.

Pressure: Ordinary, 40 lbs. Fire, 85 lbs.

Financial.—Cost, withheld, est., $50,000. Debt, $40,000. Int., 5%

Management.—Five Comrs. Prest., H. H. Porter. Supt., Jas. Mann. Latest report, Dec. 28, '89.

EAST SAGINAW, *Saginaw Co.* (Pop., 19,016; est., 33,000.) On east bank of Saginaw river, 16 miles from Lake Michigan, at head of navigation. Manufactures lumber, salt, furniture, machinery, boilers. Settled in '49; incorp. village in '54, city in '59. Has sewers and electric lights.

History.—Built in '73 by city. Contrs., Holly Mfg. Co., Lockport, N. Y.

Water Supply.—Saginaw river, through gravel filter in intake crib, direct pumping.

Intake Conduits.—Two 30-in., wood, 552 ft. long.

Pumping Machinery.—Dy. cap., 9,000,000 galls.: 2,000,000 Holly quadruplex, 1,000,000 Holly rotary, driven by horizontal, high-pressure engine, 16x24-in. cylinder; 6,000,000 Holly quadruplex, comp., cond., put in operation April, '83, since when first

pumps have not been in regular use. A 12,000,000 Gaskill, horizontal comp., contracted for, fall of '89. *Boilers:* 5 horizontal tabular, 5x16 ft.

Distribution.—*Mains*, c. i. 40½ miles. *Services*, w. i., lead. *Taps*, 1,995. *Meters*, Crown, Union, Worthington, 134. *Hydrants*, Holly, Mathews, 270. *Valves*, Galvin, Flower.

Consumption, 3,075,456 galls. *Pressure*: Ordinary, 40 lbs. Fire, 80 lbs.

Financial.—Cost, $503,090. Debt, $410,000: $55,000 at 8, $29,000 at 7, $50,000 at 6, $223,500 at 5, $52,500 at 4%. Ann. op. exp., $16,387. Ann. rev.: consumers, $30,083; city pays int. on debt.

Op. exp. for '75 were $12,602; rev., $7,393. For '80 op. exp. were $8,571, and rev. $9,561.

Management.—Five Comrs. Secy., H. M. Newton. Inspector, Jno. Weller.

EAST TAWAS, *Iosco Co.* (Pop., 712; est., 3,000.) Engaged in lumber and fish industries. Incorp. No sewers or electric lights.

History.—Built in '87-8 by village. Des. Engrs., Solon Sawyer and A. L. Holmes. Const. Engrs. and Contrs., Michigan Pipe Co., Bay City; A. L. Holmes, Grand Rapids.

Water Supply.—Lake Huron, by direct pumping.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two 750,000 [contract requirements] Gaskell dup. *Boilers:* steel.

Distribution.—*Mains*, Wyckoff wood, 5 miles. *Taps*, 220. *Meters*, none. *Hydrants*, kind not given, 76.

Consumption, 375,000 galls. *Pressure*: Ordinary, 30 lbs. Fire, 60 to 90 lbs.

Financial.—Cost, $30,000. Bonded debt, $25,000. Int., 6%. Ann. op. exp., $2,000. Ann. rev.: consumers, $1,000; city, $1,500.

Management.—Secy., C. H. Hubbell. Supt., J. J. Alguire.

EDMORE, *Montcalm Co.* (Pop., 704; est., 1,200.) On divide of Lake Huron and Michigan water-sheds. Manufactures lumber. Settled and incorp. in '78.

History.—Built in '81 by village. Engr. and Contr., James Slemons. Contr. for extensions, A. L. Holmes, Grand Rapids.

Water Supply.—Well 16 ft. diam x 32 ft. deep, with 10 2-in. tube wells driven 50 ft. in its bottom, pumping to reservoir and direct.

Pumping Machinery.—Dy. cap., 500,000 galls.; two Dean single, direct-acting, with 10 x 12-in. steam, 6-in. water cylinders. *Boilers:* two 25-H. P., vertical.

Reservoir.—Cap., about 75,000 galls.; 32 ft. diam. x 12 ft. deep, with 8-in. brick walls, and 6-in bottom on 2 ft. of concrete; 40 ft. above pumps, 20 above village.

Distribution.—*Mains*, w. i., 1 mile. *Services*, w. i. Pipe and specials from National Tube Works Co., McKeesport, Pa. *Taps*, 25. *Meters*, none. *Hydrants*, Flower. *Valves*, Flower.

Consumption, 8,000 galls. *Pressure:* Ordinary, 10 lbs. Fire, 140 lbs.

Financial.—Cost, $8,500. No debt. Ann. op. exp., $500. Ann. rev.: consumers, $300; city, none.

Management.—Fire Com. of two. Report by Jas. S. Crowns.

ESCANABA, *Delta Co.* (Pop., 3,036; est., 7,000.) On Little Bay de Noquette, at north of Green bay. Engaged in lumber and iron industries. Incorp. No sewers. Has electric lights.

History.—Built in '87 by Escanaba Water-Works Co. Controlled by Moffett Hodgkins & Clarke, Engrs. and Contrs., Syracuse, N. Y.

Water Supply.—Green bay, filtered, by direct pumping.

Intake Pipe.—Extends into bay, 2,300 ft.

Filter.—No data.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; Worthington, comp.

Distribution.—*Mains*, c. i., 10 miles. *Services*, galv. i. *Taps*, 287. *Meters*, 1. *Hydrants*, Ludlow, 83. *Valves*, Ludlow.

Consumption, 122,000 galls. *Pressure:* Ordinary, 30 lbs. Fire, 150 lbs.

Financial.—Cost, $125,000. Debt, $100,000. Int., 6%. Ann. op. exp., $3,000. Ann. rev.: consumers, $6,000; city, $4,000. Hydrant rental, $48.

Management.—Prest., J. V. Clarke. Supt., W. H. Lafleur.

EVART, *Osceola Co.* (Pop., 1,302; est., 2,000.) On Muskegon river. Has good water-power; manufactures lumbering tools. Settled in '74. Incorp. No sewers or electric lights.

History.—Built in '79-80 by village.

Water Supply.—Spring and two wells, one 8, and the other 15 x 10 ft., by direct pumping. In case of fire, water from a creek is turned into wells.

Pumping Machinery.—Dy. cap., 2,250,000 galls.; three Walker; formerly Dixon & Perkins.

Distribution.—*Mains*, Wyckoff wood, 2 miles. *Services*, Wyckoff wood, iron. *Taps* (in '86), 125. *Meters*, none. *Hydrants*, Holly, 20. *Valves*, Eddy.

Consumption, 35,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 90 lbs.

Financial.—Cost, $25,000. Debt, $8,000. Int., 6%. Ann. op. exp., $1,500. Ann. rev.: total (in '87), $1,500.

Management.—Three Comrs. Chn., C. W. Rose.

FARWELL, *Clare Co.* (Pop., 521; est., 1,000.) Engaged in lumbering. Incorp. village. No sewers or electric lights.

History.—Built in '87-8 by village; put in operation May 1, '88. Engr. and Contr., M. Walker, Fenton.

Water Supply.—Spring brook, direct pumping.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Walker.

Distribution.—*Mains*, 8 to 6-in., material not given, 2¼ miles. *Services*, ¾-in. *Taps*, 150. *Meters*, none. *Hydrants*, Ludlow, 27. *Valves*, Ludlow.

Consumption, 500,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 140 lbs.

Financial.—Cost, $12,000. Bonded debt, $12,000. Int., 7%. Ann. op. exp., $1,050. Ann. rev.: consumers, $500.

Management.—Secy., C. A. Lyon. Supt., J. N. Brown.

FENTON, *Genesee Co.* (Pop., 3,807; est., 5,000.) On Shiawassee river. Has water-power and various manufactories. Incorp. village. "But little" sewerage. No electric lights.

History.—Built in '89 by village; put in operation Jan. 1, '90. Engr. and Contr., M. Walker, Fenton.

Water Supply.—Artesian wells, direct pumping.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Walker.

Distribution.—*Mains*, 10 to 4-in. c. i., 6½ miles. *Services*, kal. i. *Hydrants*, Ludlow, 52. *Valves*, Walker.

Pressure: Ordinary, 50 lbs. Fire, 80 to 125 lbs.

Financial.—Cost, $28,000. Debt, $28,000. Int., 5%.

Management.—Clerk, Chas. M. Topping. Treas., Jno. S. Clark. Report, about March 5, '90.

FLINT, *Genesee Co.* (Pop., 8,400; est., 13,000.) On Flint river, which furnishes water-power used in manufacturing. Incorp. Partially sewered. Has electric lights.

History.—Built in '83 by Flint City Water-Works Co., under 30-years franchise. Engrs. and Contrs., Holly Mfg. Co., Lockport, N. Y.

Water Supply.—Wells, Swartz creek and Thread river, by direct pumping. There is a reservoir; not described.

Pumping Machinery.—Dy. cap., 6,000,000 galls.; two 1,500,000 Gaskill, horizontal, comp., two 750,000 Walker; others not given.

Distribution.—*Mains*, c. i., 13¾ miles. *Services*, galv. i. *Taps*, 627. *Meters*, 5. *Hydrants*, Holly, 109. *Valves*, Holly.

Consumption, 762,316 galls. *Pressure:* Ordinary, 45 lbs. Fire, 120 lbs.

Financial.—Cost, $134,026. Cap. stock, $150,000. Int. 6%. Bonded debt, $100,000. Ann., op. ex., $4,225. Ann. rev.: consumers, $7,629; city, $6,950. Hydrant rental, $60 for first hundred, $50 for additional.

Management.—Prest., Wm. Hamilton. Secy., D. Anderson. Treas., C. S. Brown. Supt., Wm. I. Fisher.

FORT GRATIOT, *St. Clair Co.* (Pop., 1,280; est., 2,800.) One mile north of Port Huron; has railway repair shops. Incorp. No sewers. Has electric lights from Port Huron plant.

History.—Built in '86 by village. Contr. for all but buildings, M. Walker, Fenton.

Water Supply.—St. Clair river, by direct pumping.

Pumping Machinery.—Dy. cap., 750,000 galls.; Walker. *Boilers:* 4x12 ft., steel.

Distribution.—*Mains*, kal. i., 6½ miles. *Services*, w. i., lead. *Taps*, 270. *Meters*, none. *Hydrants*, Ludlow, 45. *Valves*, Galvin.

Consumption, 80,000 galls. *Pressure:* Ordinary, 35 lbs. Fire, 65 to 75 lbs.

Financial.—Cost, $29,000. Debt, $25,000. Int., 6%. Ann. op. exp., $2,000. Ann. rev.: consumers, $2,700.

Management.—Supt., J. A. McMartin.

FREMONT, *Newaygo Co.* (Pop., 902; est., 1,300.) Has foundry and flouring mills. Incorp. No sewers or electric lights.

History.—Built in '83 by village. Contr., M. Walker, Fenton.

Water Supply.—Springs and four flowing wells, by direct pumping.

Pumping Machinery.—Dy. cap., 750,000 galls.; Walker.

Distribution.—*Mains*, galv. i., 1 mile. *Services*, galv. i. *Taps*, 11. *Meters*, none. *Hydrants*, Holly, 7.

Consumption, unknown. *Pressure:* Ordinary, 40 lbs. Fire, 120 lbs.

Financial.—Cost, $6,000. No debt. Ann. op. exp., $350. Ann rev.: consumers, $400.

Management.—Secy., T. E. S. Hoppock. Supt., J. Gerber.

GAYLORD, *Otsego Co.* (Pop., est., 1,200.) Engaged in lumbering. Incorp. No sewers or electric lights.

History.—Built in '88 by village. Engrs. and Contrs., Michigan Pipe Co., Bay City; A. L. Holmes, Grand Rapids.

Water Supply.—Well, pumping to tank.

Pumping Machinery.—Dy. cap., 18,000 galls.; deep-well pump.

Tank.—Cap , 85,000 galls.; 30 x 16 ft.

Distribution.—*Mains*, 6 and 4-in. Wyckoff, 2 miles. *Taps*, 75. *Meters*, none. *Hydrants*, Holly, 18. *Valves*, Galvin.

Consumption, 4,500 galls. *Pressure*, 30 lbs.

Financial.—Cost, $8,500. Debt, $8,500. Int. 6%. Ann. op. exp., $650. Ann. rev.: consumers, $400.

Management.—Secy., W. S. Filmore. Supt. E. B. Bolton.

GLADSTONE, *Delta Co.* (Pop., est., 1,500.) In lumbering and farming district. Incorp. city. No sewers or electric lights.

History.—Built in '89 by city; put in operation Sept. 15. Engr., Jas. Wilson Supt.

Water Supply.—Little bay de Noc, at head of Green bay, direct pumping.

Intake.—Diam., 12 ins.; extends 700 ft. into bay, to 32 ft. of water.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two 1,000,000 Buffalo comp. dup., non-cond. *Boilers:* Buffalo.

Distribution.—*Mains*, 12 to 4-in. c. i., 4½ miles. *Services*, galv. i., with 2-in. lead at main. Pipe and specials from Lake Shore Foundry, Cleveland, O.; laid by Keating & Sheehan, Detroit. *Hydrants*, Galvin, 32. *Valves*, Galvin.

Pressure: Ordinary, 45 lbs. Fire, 85 lbs.

Financial.—Cost, $33,000. Debt, $35,000. Int., 7%.

Management.—Supt., Jas. Wilson. Report, Sept. 11, '89.

GLADWIN, *Gladwin Co.* (Pop., 467; est., 1,000.) On Cedar river.

History.—Built in '88 by village; put in operation Nov. 1, '89. Engrs. and Contrs., Michigan Pipe Co., Bay City, Mich.

Water Supply.—River and artesian wells, direct pumping.

Pumping Machinery.—Dy cap., 1,000,000 galls; Gordon & Maxwell.

Distribution.—*Mains*, 8 and 6-in. Wyckoff, 1 mile. *Taps*, not given, est., 30. *Hydrants*, Gaskill, 9. *Valves*, Galvin.

Consumption, not determined. *Pressure*, not given.

Financial.—Cost, $6,000. Debt, $7,000. Int., 7%. Ann. op. exp. and ann. rev., not determined.

Management.—Village Council. Prest., T. H. Spencer. Clerk, Eugene Foster.

GRAND HAVEN, *Ottawa Co.* (Pop., 4,862; est., 6,000.) On Lake Michigan at the mouth of Grand river. Has good harbor, and is a summer resort. Manufactures lumber and leather.

CITY'S WORKS.

History.—Built in '80 and extended in '88 by village. Consult. Engr., Peter Hogan, Albany, N. Y. Const. Engr. and Contr. for extensions, A. L. Holmes, Grand Rapids, Mich.

Water Supply.—Driven wells, and one open well, direct pumping. A number of 2½-in. wells were driven in 4 lines radiating from pump-well. Each pipe, or tube, has perforated point 6 ft. long; wells are 32½ ft. deep, connected with pump-well by 4 and 6-in. suction pipes.

Pumping Machinery.—Dy. cap., 2,250,000 galls.; 3 Walker pumps with 14 x 12-in. steam and 8-in. water cylinders.

Distribution.—(In '87.) *Mains*, c. i., Wyckoff, 4 miles. *Services*, w. i., galv. i. *Taps*, 150. *Meters*, not given. *Hydrants*, Chapman, Galvin, 37. *Valves*, Chapman, Galvin.

Consumption (in '87), 180,000 galls. *Pressure*: Ordinary, 45 lbs. Fire, 120 lbs.

Financial.—(In '87.) Cost, $19,000. No debt. Ann. op. exp. (for '86), $1,800. Ann. rev.: consumers, withheld, est., $2,400.

Management.—Supt., A. L. Holmes.

GRAND HAVEN WATER-WORKS CO.

History.—Built in '84. Engr., S. L. Wiley, Omaha.

Water Supply.—Driven wells, by direct pumping.

Pumping Machinery.—Dy. cap., over 1,000,000 galls.; 1,000,000 Worthington; also Walker.

Distribution.—*Mains*, 12 to 4-in. c. i., 12 miles. *Services*, galv. i., lead. Pipe and specials from Cincinnati & Newport Iron & Pipe Co., Newport Ky., and Ohio Pipe Co., Columbus. *Taps*, 280. *Meters*, Crown, 5. *Hydrants*, Ludlow, 70. *Valves*, Ludlow.

Consumption, 400,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 90 lbs.

Financial.—Cost, $130,000. Cap. stock, $60,000. Bonded debt, $70,000. Int., 6%. Ann. op. exp., $2,000. Ann. rev.: consumers, $2,200; city, $4,200. Hydrant rental, $60.

Management.—Prest., S. L. Wiley, Omaha, Neb. Secy., S. M. Wiley. Supt., A. M. Cosgrove.

NOTE.—Feb. 8, '90, Co. and city were in litigation; city claims Co. has not fulfilled its contract, and for 3½ years former has refused to pay hydrant rental. Co. claims that city is meanwhile building up its works, charging consumers but one-half Co.'s rates. Suit has been carried to U. S. Supreme Court.

GRAND RAPIDS, *Kent Co.* (Pop., 32,016; est., 60,000.) At head of navigation on Grand river, 30 miles from Lake Michigan. River here falls 17 ft. in two miles, furnishing good water-power used in manufacturing. Has electric lights.

GRAND RAPIDS HYDRAULIC CO.'S WORKS.

History.—Built in '40; extended from time to time until city built works in '73-5, after which little seems to have been done until '88, when new works were built, old wooden mains being retained for former gravity supply.

Water Supply.—Springs and surface well, pumping to stand-pipe. First supply was from hillside springs; in '61 a brook formed by springs known as "The Penney Eighty" was drawn upon. In '64 a reservoir was built near head of brook, and in '70 connections made with additional springs. In '72 well was sunk to deep gravel strata 30 ft. in diam., 20 ft. deep, water standing to a depth of 14 ft.; constructed by building a brick wall, bound with iron, on iron shoe with a cutting edge, and excavating from inside, the weight of the wall carrying it down. Plastered inside and out with gravel so water can enter only from the bottom. The supply from springs is still by gravity, through the old wooden pipe.

Suction Pipe.—From well; 12 in., 150 ft. long.

Pumping Machinery.—Dy. cap., about 3,000,000 galls.; Blake dup., comp., cond., low and high-pressure; latter held in reserve. *Boilers:* two 120-H. P. Phœnix.

Force Mains.—*Old:* no data. *New:* 24-in., laid in '89.

Stand-Pipe.—Cap., 235,000 galls.; 100 ft. high; about 250 ft. above river; steel plate, 5 x 8 ft., ⅝ ins. thick.

Distribution.—*Mains*, iron, wood, about 30 miles. First iron pipe laid in '57. In '86 there were two miles of wooden logs, and 10 miles of logs covered with iron.

No further data.

CITY'S WORKS.

History.—Built in '73-5. Des. Engr., Peter Hogan, Albany, N. Y. Const. Engr., E. W. Muenscher, then City Engr. Extensive improvements made in '88-90.

Water Supply.—Carrier creek, Cold brook and Grand river, pumping to reservoir and direct. Prior to '88 or '89 Grand River was drawn upon only in case of emergency, main supply being from impounding reservoir, described below. In these years additional intake was built in river, filtering bed begun, high and low service established, new pumps and a stand-pipe added or contracted for.

Dam and Impounding Reservoir.—Cap., not given; water area, 18.3 acres; 7 sides, 33 to 356 ft. long; near junction of Carrier creek and Cold brook; 20-in. c. i. pipe leading from each to reservoir. In excavation and embankment, in impervious clay; inner slopes paved with dry stone. Dam at lower end, masonry, 50 ft. long, 8 to 18 feet high, 23 ft. wide on top at highest part

Conduit.—Water passes from reservoir through channel 4 ft. wide, 32 ft. long, having retaining walls, to outlet chamber of stone masonry; from this a 20-in. conduit leads to pump-well; first 133 ft., c. i., remaining distance, 1,860 ft., pine staves, banded with iron.

Grand River Intake Crib.—*Old:* No data. *New:* 4x104 ft., x 3 ft. high; 2x12-in. hemlock plank, with spaces between planks on side for admission of water; top tightly covered; whole surrounded by fine gravel.

Grand River Intake Conduit.—New one laid in '88 or '89. No data.

Pumping Machinery.—Dy. cap., 11,000,000 galls.; two horizontal direct-acting cond., with 33x72-in. steam, 14½-in. water cylinders; made by Butterworth & Lowe, Grand Rapids; 5,000,000 pump built in '88-9 after plans by Pumping Engr., Geo. E. Kirk; Contrs., Eagle Iron Works, Detroit: also 3,000,000, Gordon high service, added in '89, with 20x18-in. steam, 12-in. water cylinders. *Boilers:* one tubular, two marine. First pump erected in '75, and duplicated in '79-80. Before works were finished temporary fire supply was furnished by an 8½-in. dup., high pressure Worthington.

Force Main.—To reservoir. Diam., 16-ins.

Stand-Pipe.—Contracts let in '89 to Porter Mfg. Co., Syracuse, N. Y.

Distributing Reservoir.—Cap., 6,000,000 galls.; depth, 20 ft.; flow-line 177 ft. above low water in river; in excavation and embankment, 196 ft. in diam. at bottom, 271 at top, 25 ft. deep, with 20 ft. of water. Bank of sand and gravel, with heart-wall; 3 ft of puddle beneath bank; 12 ft. high; 12 ft. wide on top; inner slope of 1½ to 1, paved with 1 ft. of cobble stones, laid on 17 ins. of concrete, except upper 2 ft. of slope, which has 6 ins. of cobbles set in gravel; outer slope 2 to 1, unpaved. Bottom has an 8-in. cobble stone pavement on 8 ins. of concrete. *Heart-wall:* puddle, 8 ft. thick at bottom, 5 at top, which is 3 ft. from top of bank. *Influent and effluent pipes:* 16-in. force main and 20-in. effluent pipe are carried under bank, joints enclosed in masonry piers. Force main ends in a mass of masonry; effluent pipe begins in a small masonry well, both at foot of inner slope. Built in '74-5. Engrs., see History. Contrs., T. Brooks and A. C. Sekell. Cost, $54,666.

River Crossing.—About 700 ft. long. Temporary supply was carried over on a bridge in a 6-in. Wyckoff pipe, in a box packed with sawdust. Later a 12-in. w. i. rivetted pipe with spring flanges was laid in a trench by means of sand bags and a coffer dam. It was in 17 lengths of 42 ft. each.

In '86 a 16-in. pipe was substituted for 12-in. It was furnished by city, and laid by W. R. Coats, Kalamazoo, price being $5.50 a foot for river, and 65 cents for shore section. A new, or deeper trench, was blasted, 30-in. holes being drilled 2 ft. apart. Pipe was lowered from a trestle of 70 bents, 8 ft. high, water being 4 to 5 ft. deep. Pipe was put together on trestle with hemp gasket and lead, and lowered by chain slings 24 ft. apart. Each sling was attached to a 1¼-in. screw-rod, 9 ft. long, passing through nuts on special cross-caps. Pipe was lowered in 2½ hours.

Distribution.—*Mains*, wood, iron, 48.4 miles. *Services*, lead. *Taps*, 2,156. *Meters*, Worthington, Ball & Fitts rotary and piston, Crown duplex, 471. *Hydrants*. Mathews, 526. *Valves*, Eddy.

Consumption, 2,716,736 galls. *Pressure*, 65 lbs.

Financial.—Cost, $715,886. Debt, $532,000: $382,000 at 8%; due $250,000 in '93, $100,000 in '94, $32,000 in '95; also $230,000 at 5%, due in 1908 and 1909. Am. op. exp., $22,084. Ann. rev.: Consumers, $41,839.

Management.—City Engr., H. A. Collar. Clerk and Collector, Fred. A. Twamley. Pumpg. Engr., Geo. E. Kirk. Inspector, A. Per Lee.

References.—Extended description of laying submerged pipe across Grand river was given by W. R. Coats, in a paper read before the Mich. Soc. of C. E. in '86 or '87.

Report of Special Committee on sale of city works to N. Y. Contract Co., or to M. R. Crow, of the Hydraulic Co., and on purchase of Hydraulic Co.'s plant by city. Gives history of city works, and advises against sale of same.

GRAYLING, *Crawford Co.* (Pop., 245; est., 1,600.) Engaged in lumbering. Not incorp. Has sewers and electric lights.

History.—Built in '85 by Salling, Hanson & Co.; put in operation Nov. 1. Des. Engr., S. V. Salcno, Bay City. Contr., A. L. Holmes, Grand Rapids.

Water Supply.—Ausable river, by gravity.

Distribution.—*Mains*, 6-in., 2¼ miles. *Taps*, 38. *Meters*, none. *Hydrants* 2.

Financial.—Cost, $3,000. Debt, not given. Ann. op. exp., $650. Ann. rev.: withheld, est., $700; county, $200. Hydrant rental, $75.

Management.—Owners, Salling, Hanson & Co. Report, Mar. 4, '90.

GREENVILLE, *Montcalm Co.* (Pop., 3,144; est., 4,000.) On Flat river, 23 miles from Grand Rapids. Has flour, lumber, shingle and planing mills, and barrel factory. Incorp. No sewers. Has electric lights.

History.—Built in '88 by city; put in operation in Nov. Des. Engr., J. B. Davis, Ann Arbor. Const. Engr., G. S. Williams, Saginaw. Labor done by day and local Contrs.

Water Supply.—Driven wells and river, direct pumping; river supply for fire protection; 35 2 in. wells, with 1¼-in. points.

Pumping Machinery.—Dy. cap., 1,440,000 galls.; Deane comp., dup., 10 and 16x 10-in. steam, 9¼-in. water cylinders. *Boilers:* two 50-H. P., Otis steel, upright; from McGregor Bros., Detroit.

Distribution.—*Mains*, 10 to 6-in. c. i., 5 miles. *Services*, not given. Pipe and specials from New Philadelphia (O.) Pipe Works and Detroit Pipe and Foundry Co. *Taps*, 150. *Meters*, not given. *Hydrants*, Ludlow, 40.

Financial.—Cost, $45,000. Bonded debt, $25,000. Int., 5%. Ann. op. exp. and rev., not determined.

Management.—City Clerk, A. C. Phelps. Report by L. H. Wright.

HANCOCK, *Houghton Co.* (Pop., 1,783; est., 4,000.) Has copper mines, stamp mill, smelting works and foundry.

History.—Built by village, date not given.

Water Supply.—Springs by gravity from reservoir.

Reservoir.—Cap., est., 70,000 galls.; 20 x 40 ft., x 14 ft. deep; 200 ft. above village.

Distribution.—(In '87.) *Mains*, 6-in. iron, 2 miles. *Services*, not given. *Taps*, 500. *Meters*, none. *Hydrants*, kind not given, 15.

Consumption, unknown. *Pressure*, 200 ft. head.

Financial.—(In '87.) Cost, $8,000. No debt. Ann. op. exp. and rev., not given; tax of ½% is levied.

Management.—(In '88.) Seven Trustees. Report by Thos. Smart.

NOTE.—No reply to inquiries sent in '89.

HARRISON, *Clare Co.* (Pop., 129; est., 800.)

History.—Built in '85 by village. Engrs. and Contrs., Michigan Pipe Co., Bay City.

Water Supply.—Budd lake, by direct pumping.

Pumping Machinery.—Dy. cap., 750,000 galls.; two Walker.

Distribution.—(In '87.) *Mains*, Wyckoff wood, 1½ miles. *Services*, w. i. *Taps*, 110. *Meters*, none. *Hydrants*, Bailey, 15. *Valves*, Eddy.

Consumption (In '87.), 55,500 galls. *Pressure:* Ordinary, 45 lbs. Fire, 80 lbs.

Financial.—(In '87,) Cost, $8,000. Debt, $3,500. Int., 6%. Ann. op. exp., $1,200. Ann. rev.: consumers, $750.

Management.—(In '88.) Village Council. Secy., A. H. Hudson.

NOTE.—No reply to inquiries sent in '89.

HART, *Oceana Co.* (Pop., est., 1,000.) Incorp. village.

History.—Built in '86 by village. Contr., M. Walker, Fenton.

Water Supply.—River, direct pumping.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; two Walker.

Distribution.—*Mains*, 8-in. c. i., ½ mile. *Services*, w. i. Pipe and specials from R. D. Wood & Co., Philadelphia; trenching and pipe-laying done by Bailey & Cahill. *Taps*, 32. *Hydrants*, 7.

Pressure: Ordinary, 60 lbs. Fire, 150 lbs.

Financial.—Cost, $6,000. Bonded debt, $4,000. Int., 8%. Ann. op. exp., $150. Ann. rev.: consumers, $140.

Management.—Secy., F. H. Edwards. Supt., Jas. Tennant. Report, Sept. 9, '89.

HASTINGS, *Barry Co.* (Pop., 1,284; est., 3,000.) On Thornapple river, 32 miles from Grand Rapids. Incorp. No sewers or electric lights.

History.—Built in '86-7 by village. Engr., W. R. Coats, Kalamazoo. Contr., Geo. C. Morgan, Chicago, Ill.

Water Supply.—Well, 20x30 ft., by direct pumping.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two Deane, dup., high-pressure.

Distribution.—*Mains*, 8 to 4-in. c. i., 4 miles. *Services*, w. i. *Taps*, 200. *Meters*, none. *Hydrants*, Morgan, 40. *Valves*, Crane.

Consumption, 300,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 80 to 100.

Financial.—Cost, $30,000. Bonded debt, $25,000. Int., 4½%. Ann. op. exp. $2,000. Ann. rev.: consumers, $1,500.

Management.—Three Comrs.: Prest., W. L. Wilkins, W. D. Hayes. W. C. Kelly.

HILLSDALE, *Hillsdale Co.* (Pop., 3,441; est., 4,000.) In undulating country. Incorp. Has sewers and electric lights.

History.—Built in '85-6 by village. Engr., J. D Cook, Toledo, O.

Water Supply.—Bawbeese lake, by direct pumping.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; Blake. *Boiler:* tubular.

Distribution.—(Mar. 4, '89.) *Mains*, c. i., 9 miles. *Services*, w. i. Pipe and specials from Cincinnati & Newport Iron & Pipe Co., Newport, Ky.; trenching and pipe-laying done by M. Philbin, Chicago, Ill. *Taps*, 422. *Meters*, none. *Hydrants*, Flower, 69. *Valves*, Eddy.

Consumption, 295,681 galls. *Pressure:* Ordinary, 45 lbs. Fire, 80 to 130 lbs.

Financial.—(Mar. 4, '89.) Cost, $60,000. Debt, $45,000. Int., 4½%. Ann. op. exp.. $2,359. Ann. rev.: consumers, $2,617.

Management.—Comrs. Chn., G. H. McDermid.

HOLLAND, *Ottawa Co.* (Pop., 2,620; est., 4,000.) On Macatawa bay, 25 miles from Grand Rapids. Engaged in lumbering, tanning and manufacturing flour. Incorp. No sewers or electric lights.

History.—Built in '85 by village. Engr. and Contr., M. Walker, Fenton. Contr. for extensions, A. L. Holmes, Grand Rapids.

Water Supply.—Springs, by direct pumping from collecting reservoirs. Contract let in Nov., '89, for well 63 ft. deep, 16 ft. in diameter first 30 ft., 16 for remainder; lined with brick and cem. Contract price, $2,370

Reservoirs.—One 12 and one 16 ft. in diam., each 16 ft. deep.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; two Walker, direct-acting. *Boilers:* two, horizontal, tubular, 4 x 12 ft.

Distribution.—*Mains*, c. i., 4½ miles. *Services*, galv. i., lead. Pipe and specials from Cincinnati & Newport Iron & Pipe Co., Newport, Ky.; trenching and pipe-laying done by Alba L. Holmes, Grand Rapids. *Taps*, 123. *Meters*, none. *Hydrants*, Ludlow, 39. *Gates and boxes*, Galvin.

Consumption, 150,000 galls. *Pressure:* Ordinary, 38 lbs. Fire, 100 lbs.

Financial.—Cost, $28,268. Debt, $23,600. Int., 5%. Ann. op. exp., $2,700. Ann rev., consumers, $1,600; money raised by general taxation to meet balance of expenses.

Management.—Comrs. Chn., and Supt., Jno. Kramer. Secy., Geo. H. Sipp.

HOLLY, *Oakland Co.* (Pop., 1,443; est., 1,500.) On Shiawassee river. Has sewers. No electric lights.

History.—Built in '79 by village. Const. Engr. and Contr., M. Walker, Fenton.

Water Supply.—Shiawassee river, direct pumping.

Intake Pipe.—Is 8 ins. in diam., 359 ft. long.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two 750,000 Walker, of 14 x 12-in. steam, 7¼-in. water cylinders, erected in '79; others not given.

Distribution.—*Mains*, 8 and 4-in. Wyckoff, 3 miles. *Services*, not given. *Taps*, 100. *Meters*, none. *Hydrants*, Galvin, 18. *Valves*, Galvin.

Consumption, 135,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 100 lbs.

Financial.—Cost (in '87), $10,000. Debt, $2,000. Int., 5%. Ann. op. exp., $1,200. Ann. rev.: consumers, $1,400.

Management.—Secy., W. H. Jones. Supt., L. J. Striggon.

HOWARD CITY, *Montcalm Co.* (Pop., 924; est., 1,500.) Manufactures lumber. Incorp. village. No sewers or electric lights.

History.—Built in '90 by village; put in operation March 15. Engr. and Contr. M. Walker, Fenton.

Water Supply.—River, direct pumping; tube wells to be put down soon.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; Walker.

Distribution.—*Mains*, 8 to 4-in. c. i., 1 mile. *Hydrants*, Ludlow, 13.

Pressure: Ordinary, 35 lbs. Fire, 80 to 100 lbs.

Financial.—Cost, $10,000. Bonded debt, $8,000. Int., 6%.

Management.—Three Comrs. Clerk. W. Lisk. Supt., C. C. Messenger. Report, Mar. 3, '90.

IONIA, *Ionia Co.* (Pop., 4,190; est., 5,000.) Is ¾ miles from Grand river on level ground at foot of bluff. Settled in '42. Incorp. in '75. Has sewers and electric lights.

History.—Built in '76 by village. Des. Engrs., Geo. Briggs and Jas. Bell. Contr. for extensions, A. L. Holmes, Grand Rapids.

Water Supply.—Springs, surface water, and 4 artesian wells, by direct pumping. Springs are on hill within village limits, and water passes from them through marsby ground for about ¼ mile to reservoir. Wells are 400 ft. deep.

Reservoir.—Wooden, 30 ft. in diam., 44 ft. above village.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two 1,000,000. Smith & Vaile. *Boilers:* marine.

Distribution.—(Mar. 31, '89.) *Mains*, Wyckoff, 12, c. i., 1½, kal. i., ¼, total, 14 miles. *Services*, galv. i., lead. Pipe and specials from Michigan Pipe Co., Bay City, and Lake Shore Foundry, Cleveland, O. *Taps*, 539. *Meters*, none. *Hydrants*, Holly, Flower, Ludlow, Mathews, Galvin, Gaskill's improved, 105. *Close of '80:* Mains, 1½ miles. Taps, 5. Meters, none. Hydrants, 7.

Consumption, 300,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 105 lbs.

Financial.—(Mar. 31, '89.) Cost, $102,810. Debt, $37,017; $7,017 at 7, $30,000 at 6%. Ann. op. exp., $1,298. Ann. rev.: consumers, $4,091.

Management.—Comr. and Supt., Frank C. Sibley. Secy., Robt. Beard.

IRONWOOD, *Gogebic Co.* (Pop., est., 6,000.) Engaged in mining. Incorp. village. No sewers. Has electric lights. See Hurley, Wis.

ISHPEMING, *Marquette Co.* (Pop., 6,039; est., 10,000.) Engaged in mining. Has electric lights.

History.—Built in '82 by city.

Water Supply.—Lake Angeline, by direct pumping. In '89 contracts were let to Michigan Pipe Co., Bay City, to lay main from Lake Sally to pumping station; price, $33,500.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Worthington. *Boilers:* two, tubular, 5 x 15 ft. Contract let latter part of '89 for 3,000,000 Worthington pump.

Distribution.—(In '87.) *Mains*, Wyckoff wood, 9.2 miles. *Services*, galv. i. *Taps*, withheld. est., 500. *Meters*, none. *Hydrants*, kind not given, 54.

Consumption, not given. *Pressure:* Ordinary, 50 lbs. Fire, 95 lbs.

Financial.—(In '87.) Cost, $70,000. Debt, $45,000. Int., 5%. Ann. op. exp., $6,292. Ann. rev.: consumers, $8,383.

Management.—(In '88.) Water Board of three: P. T. Divine, H. H. Mildare and C. H. Hall, Supt.

NOTE.—No reply to inquiries sent in '89.

ITHACA, *Gratiot Co.* (Pop., 600; est., 2,000.)

General Description.—In '84 village sunk a well 700 ft. Water is pumped to a tank at an elevation of 20 ft., from which it is distributed to cisterns for fire protection and to a few factories. There is less than a mile of pipe, and 7 or 8 taps. What has been done already has cost about $1,000. There is no debt. Village Marshal is paid $360 a year for operating works. Complete system is contemplated, but present well will not furnish suitable supply. Report by Jas. P. Gibbs.

NOTE.—Above given in '88, since when no official information can be obtained. It was unofficially reported that an 8-in. well, 550 ft. deep, was sunk in '89, affording good supply, and that works were to be built.

JACKSON, *Jackson Co.* (Pop., 16,105; est., 24,000.) On both sides of Grand river. Manufactures machinery, paper and various other things. Settled in '29; incorp. village in '43, city in '57. Has sewers and electric lights.

History.—Built in '70 by private Co., bought by city in '71. Des. Engr., B. Holly, Lockport, N. Y. Const. Engr., Wm. Bennett, Jackson.

Water Supply.—Artesian wells, direct pumping. First two wells are 6 ins. in diam., 203 ft. deep, and in '81 a 10-in. well was begun.

Pumping Machinery.—Dy. cap., 7,000,000 galls.; 1,500,000 Holly quadruplex, 4,000,000 Gaskill horizontal. At first two Holly rotary pumps were used. *Boilers:* horizontal, tubular.

Distribution.—*Mains*, c. i., 28½ miles. *Services*, w. i., lead. Pipe and specials from Cincinnati & Newport Iron and Pipe Co.; pipe-laying done by city. *Taps*, 1,940. *Meters*, 56. *Hydrants*, Holly, 270. *Valves*, Holly. *Pressure-recording gauge*, Edson.

Consumption, 1,890,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 100 lbs.

Financial.—Cost, $400,000. Debt, $160,000: $110,000 at 8, $50,000 at 5%. Ann. op. exp., $9,500. Ann. rev.: consumers $18,000. In '80, op. exp. were $7,000, rev., $8,251.

Management.—Board of Public Works. Prest., Wm. R. Brown. Secy., J. K. Rogent.

KALAMAZOO, *Kalamazoo Co.* (Pop., 11,937; est., 22,000.) On Kalamazoo river. Has various manufactories and electric lights.

History.—Built in '69 by city. Des. Engr., Birdsall Holly, Lockport, N. Y. Const. Engr., Galen W. Pearsons, Kansas City, Mo. No Contr. for labor.

In '60 Geo. Bales contracted to pump water for fire protection, and before this water for the same purpose had been taken from Mich. Central R. R. Co.'s tank, the waste flowing to cistern at court house.

Water Supply.—Two surface wells, by direct pumping. First well sunk in '72; 24 ft. in diam., 40 ft. deep; when finished water stood in it 24 ft. deep; Sept. 10, '88, water was 10½ ft. deep. Wall was built on c. i. shoe with cutting edge, and sunk by excavating from inside, through 14 ft. of fine sand into porous gravel. Water was not pumped out during the process. Second well was sunk in '87-8 under direction of W. R. Coats, Kalamazoo.

Supply in '69 was taken from well sunk near and 7 ft. lower than Axtell's brook, but water being impure, this well was abandoned.

Conduit.—Connects wells; c. i., 24-in.; 3,120 ft. long.

Pumping Machinery.—Dy. cap., 7,000,000 galls.; 2,000,000 Holly quadruplex, 2,000,000 Worthington, 3,000,000 Gaskill vertical; first two are old.

Distribution.—*Mains*, 24 to 2-in. c. i. 24.3 miles. *Services*, w. i., lead. Pipe and specials from R. D. Wood & Co., Philadelphia, Pa., Dennis Long & Co., Louisville, Ky., Lake Shore Foundry, Cleveland, O. *Taps*, about 1,200. *Meters* (in '87), 7. *Hydrants*, Holly, Gaskill, Ludlow, 232. *Valves*, Holly, Ludlow, Chapman, Flower.

Consumption, 1,790,660 galls. *Pressure:* Ordinary, 45 lbs. Fire, 88 lbs.

Financial.—Cost, about $350,000. Debt, not given. Ann. op. exp., $8,330. Ann. rev.: consumers, $13,173.

Management.—Chf. Engr. and Supt., Geo. H. Chandler.

LAKE CITY, *Missaukee Co.* (Pop., est., 700.) On Lake Muskrat. Engaged in farming and lumbering. Incorp. No sewers or electric lights.

History.—Built in '88 by Daniel Reeder & Co. Engr., H. H. Greene, Cadillac. Village has contracted for hydrants for six years, with privilege of buying works at end of that time.

Water Supply.—Muskrat lake, by direct pumping.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Davidson *Boilers:* from W. Hayes, Cadillac.

Distribution.—*Mains*, 6 and 4-in. Wyckoff. ½ mile; from Michigan Pipe Co., Bay City. *Taps*, 11. *Hydrants*, Galvin, 6. *Valves*, Ludlow.

Consumption, 500 galls. *Pressure:* Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—Cost, $6,000. Cap. stock, $5,000. No debt. Ann. op. exp., $730. Ann. rev.: consumers, $240; city, $1,200. Hydrant rental, $15.

Management.—Owner, D. Reeder & Co.

LAKE LINDEN, *Houghton Co.* (Pop., 2,600; est., 3,000. Engaged in lumbering, copper mining and stamping.

History.—Built in '87 by village. Des. Engr., Jas. P. Edwards. Labor done by day.

Water Supply.—Artesian well and creek, by direct pumping from former for domestic use, and by gravity from latter for fire protection.

Reservoir.—Is 60 x 80 ft., x 16 ft. deep.

Pumping Machinery.—Dy. cap., 35,000 galls.; from Gray Bros.

Distribution.—(In '87.) *Mains*, iron, 2½ miles. *Services*, not given. *Taps*, 75. *Meters*, none. *Hydrants*, kind not given, 33.

Consumption (in '87), 35,000 galls. *Pressure:* Ordinary, 50 lbs. Fire, 100 lbs.

Financial.—(In '87.) Cost, $40,000. Bonded debt, $40,000. Int., 6%. Ann. op. exp., not given. Ann. rev.: consumers, $1,500; city, $2,400.

Management.—(In '88.) Secy., D. W. Sutter. Supt., L. Deschamps.

NOTE.—No reply to inquiries sent in '89.

LANSING, *Ingham Co.* (Pop., 8,319; est., 12,000.) On Grand river, which furnishes water-power used in manufacturing. Incorp. Has sewers and electric lights.

History.—Built in '86 by city. Des. Engr., Chester B. Davis, Chicago, Ill. Const. Engrs., Meyers & Son. No Contrs. for labor except for pipe-laying.

Water Supply.—Eight tile-lined wells, 34 ft. deep, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; Worthington. *Boilers:* two, tubular.

Stand-Pipe.—Cap., 289,000 galls.; 18 x 152 ft. Contrs., Lansing Iron & Engine Works.

Distribution.—*Mains*, c. i., 22 miles *Services*, lead. Pipe and specials from Cincinnati & Newport Iron & Pipe Co.; trenching and pipe-laying done by Meyers & Son. *Taps*, 950. *Meters*, 30. *Hydrants*, Ludlow, 200. *Valves*, Ludlow.

Consumption, 900,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 65 lbs.

Financial.—Cost, $145,000. Debt, $100,000. Int., 4½%. Ann. op. exp., $6,000. Ann. rev.: consumers, $9,300; city, $7,850. Hydrant rental, $35.

Management.—Board of 5. Secy., H. D. Bartholomew. Supt., W. S. Wright.

LAPEER, *Lapeer Co.* (Pop., 2,911; est., 3,000.) Incorp. No sewers. Has electric lights.

History.—Built in '88 by village. Engr. and Contr., M. Walker, Fenton.

Water Supply.—Three flowing artesian wells, about 180 ft. deep, by direct pumping. Overflow from wells goes to small reservoir for reserve in case of fire.

Reservoir.—Cap., 30,000 galls.

Pumping Machinery.—Dy. cap., 1,750,000 galls.; two Walker.

Distribution.—*Mains*, 10 to 4-in. c. i., 2-in. kal. i., 11 miles. *Services*, lead, kal. i. *Taps*, 200. *Meters*, none. *Hydrants*, Ludlow, 70. *Valves*, Eddy.

Consumption, 150,000 galls. *Pressure:* Ordinary, 38 lbs. Fire, 95 to 100 lbs.

Financial.—Cost, $41,000. Bonded debt, $40,000. Int., 5%. Ann. op. exp., est., $1,500. Ann. rev., est., $1,800.

Management.—Five Comrs. Secy., S. D. Brown. Supt., G. F. Demorest.

LOWELL, *Kent Co.* (Pop., 1,538; est., 2,500.) On Grand river, 18 miles from Grand Rapids.

History.—Built in '87, put in operation Jan., '88, by Lowell Water Co. Engr., A. C. Sekell; all labor done by day under his direction.

Water Supply.—Twenty driven wells, pumping to reservoir.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Smith & Vaile, dup., high-pressure. *Boiler:* 40-H. P., vertical.

Reservoir.—Is 34 ft. in diam. and water stands 8 ft. deep.

Distribution.—(In '87.) *Mains*, c. i., 3⅝-miles. *Services*, lead, iron. Pipe and specials from Detroit Pipe & Foundry Co. *Taps*, not given, est., 150. *Meters*, none. *Hydrants*, Chapman, 50. *Valves*, Chapman.

Consumption, not given. *Pressure*, 65 lbs.

Financial.—(In '87.) Cost, about $22,000. Cap. stock, $30,000. Authorized bonds, $30,000. Int., not given. Ann. op. exp., withheld, est., $1,000. Ann. rev.: total, withheld, est., $3,000. Hydrant rental, $50.

Management.—(In '88.) Prest. Edwin F. Sweet. Secy., Edgar W. Ford. Supt. and Mgr., A. C. Sekell.

NOTE.—No reply to inquiries sent in '89.

LUDINGTON, *Mason Co.* (Pop., 4,190; est., 7,000.) On Lake Michigan at mouth of Pere Marquette river. Engaged in lumber trade, and has salt and iron works. Settled in '67; incorp. city in '73. Has electric lights.

History.—Built by Ludington Water Co. in '82. Contr., M. Walker, Fenton.

Water Supply.—Lake Michigan and Pere Marquette river, by direct pumping.

Pumping Machinery.—Dy. cap., 4,500,000 galls.; two 750,000 Walker, of 7 x 14 ins., 3,000,000 Gaskill dup.

Distribution.—(In '87.) *Mains*, Wyckoff wood, 6¼ miles. *Services*, w. i., lead. *Taps*, 230. *Meters*, none. *Hydrants*, Holly, Galvin, 80.

Consumption (in '87), 300,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—(In '87.) Cost, $55,000. No debt. Ann. op. exp., $3,500. Ann. rev.: consumers, $4,500; city, $5,520. Hydrant rental, $80.

Management.—Prest., Thos. R. Lyon.

LYONS, *Ionia Co.* (Pop., 747; est., 800.) On Maple river. Has water-power. Manufactures windmills. Incorp. Has sewers. No electric lights.

History.—Built in '79 by village for fire protection and street sprinkling. No Engr. **Water Supply.**—Maple river, by direct pumping. **Pumping Machinery.**—Dy. cap., 324,000 galls.; Holly, water-power. **Distribution.**—*Mains*, Wyckoff wood, 0.3 miles. *Hydrants*, Holly, 7. *Pressure*, 100 lbs. **Financial.**—Cost, $3,000. No debt. Ann. op. exp., $50. No rev. **Management.**—Prest., E. D. Thayer. Secy., A. K Root. Supt., J. Hale.

MANISTEE, *Manistee Co.* (Pop., 6,930; est., 16.000.) On Lake Michigan at mouth of Manistee River. Manufactures shingles, salt, lumber and furniture. Incorp. Has sewers. No electric lights.

History.—Built in '82-3 by Manistee Water Co. Engrs., and Contrs., Holly Mfg. Co., Lockport, N. Y.

Water Supply.—Combined surface and driven wells, by direct pumping. Surface well is 30 ft. in diam. and depth, and in its bottom are about 50 2 and 4-in. driven wells, about half 45, remainder 100 ft. deep. Pipe has been laid to connect with Manistee river.

Pumping Machinery.—Dy. cap., 2 750,000 galls. 2,000,000 Holly, quadruplex, 14 x 25 ins., 750,000 Holly, quadruplex. There have also been connected with works two 8 x 12-in. Holly.

Distribution.—*Mains*, c. i., 19½ miles. *Services*, galv. i., lead. *Taps*, 903. *Meters*, none. *Hydrants*, Holly, 82. *Valves*. Ludlow, Eddy, Galvin.

Consumption, 700,000 galls. *Pressure:* Ordinary, 65 lbs. Fire, 85 to 140 lbs.

Financial.—Cost, $200,000. Cap. stock, $200,000. Bonded debt, $80,000. Int., 6%. Ann. op. exp., $5,000. Ann rev.: consumers, $9,000; city, $8,500. Hydrant rental, $100, 20-years contract.

Management.—Prest., E. D. Wheeler. Secy., G. A. Hart. Treas., T. J. Ramsdell. Supt., S. A. Cahill.

MARINE CITY, *St. Clair Co.* (Pop., 1,673; est., 3,000.) On St. Clair river, 20 miles from Pt. Huron. Engaged in manufacturing salt, brick, barrels, and in building boats. Incorp. No sewers or electric lights.

History.—Built in '84 by town. All labor done by day.

Water Supply.—St. Clair river, by direct pumping.

Pumping Machinery.—Dy. cap., 2,500,000 galls.; two 750,000 Walker; other, not given. *Boilers:* two tubular, steel.

Distribution.—*Mains*, c. i., 5 miles. *Services*, not given. Pipe and specials from Cincinnati & Newport Iron and Pipe Co., Newport, Ky. *Taps*, 319. *Meters*, none. *Hydrants*, Bailey, 36. *Valves*, Galvin.

Consumption, 84,330 galls. *Pressure:* Ordinary, 25 lbs. Fire, 80 lbs.

Financial.—Cost, $32,000. Debt, $32,000. Int., 6%. Ann. op. exp., $1,763. Ann. rev.: consumers, $2,715; from taxation, $300.

Management.—Comrs. Secy., H. Zimmerman. Supt., S. W. Hadden.

MARQUETTE, *Marquette Co.* (Pop., 4,690; est., 8,000.) On Lake Superior, on bluff 25 ft. above water. Has iron mines, blast furnaces, rolling and powder mills. Incorp. Has sewers and electric lights

History.—Built in '70 by town. Const. Engr., Gale & W. Pearsons, Kansas City, Mo.

Water Supply.—Lake Superior, direct pumping.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; Holly double-acting, plunger. There have been connected with works a gang of 6 single-acting 6-in. bucket pumps, with rotary pump for fire protection; also gang of 8 12-in. double-acting bucket and plunger pumps of 12-in. bore and stroke. Cylinders of engine driving former were 14 ins. in diam. with 24-in. stroke; of latter, 18 ins. in diam., 24-in. stroke.

Distribution.—*Mains*, c. i., 13½ miles. *Services*, galv. i. *Taps*, 960. *Meters*, 4. *Hydrants*, Holly, Galvin, 116. *Valves*, Ludlow, Galvin. *Close of* '70: Mains, 5 miles. Taps, 300. Meters, none. Hydrants, 40. *Close of* '80: Mains, 5½ miles. Taps, 500. Meters, 4. Hydrants, 55.

Consumption, 1,500,000 galls. *Pressure:* Ordinary, 80 lbs. Fire, 130 lbs.

Financial.—Cost, $177,688. Debt, $75,000: $14,000 at 7, $35,000 at 6, $26,000 at 5%. Ann. op. exp., $7,500. Ann. rev.: consumers, $16,800. Cost, close of 70, $74,887; do., '80, $118,009. Rev., '70, $2,107; do., '80, $6,973.

Management.—Prest. and Treas., J. M. Wilkinson. Secy and Supt., J. Kern.

MARSHALL, *Calhoun Co.* (Pop., 3,795; est., 4,000.) On Kalamazoo river. Has manufactories. Incorp. No sewers. Has electric lights.

History.—Built in '89 by Marshall Water-Works Co., controlled by Moffett, Hodgkins & Clarke, Engrs. and Contrs., Syracuse, N. Y.; put in operation about Sept. 1.

Water Supply.—Well, pumping to stand-pipe. Well, 30 ft. in diam. (probably), 30 ft. deep.

Pumping Machinery.—Dy. cap., 2,000,000 galls ; two Worthington comp.

Stand-Pipe.—Cap., 235,000 galls.; 20 x 100 ft.

Distribution.—*Mains*, 12 to 4-in. c. i., 8 miles. *Taps*, 50. *Hydrants*, 85.

Financial.—Cost, $100,000. Debt, $80,000. Int., 6%. Ann. op. exp., est., $1,500. Ann. rev.: consumers, est., $5,000; city, $4,000. Hydrant rental, about $47.

Management.—Prest., J. L. Hotchkin. Supt., R. H. Sanderson. Report, Sept. 1, '89.

MENOMINEE, *Menominee Co.* (Pop., 3,010; est., 10,500.) On low, sandy ground at mouth of Menominee river, which empties into Green bay, Lake Michigan. Considerable portion of city is on land made by filling in with sawdust and slabs. Manufactures lumber. Settled in '22; incorp. city in '83. No sewers. Has electric lights.

History.—Built in '84 by Menominee Water Co. Engr., H. F. Dunham, Cleveland, O. Contr., A. H. Howland, Boston, Mass.

Water Supply.—Green bay, by direct pumping. Water taken from crib, 1,300 ft. from shore, where water is 26 ft. deep.

Intake Pipe.—Consists of 1,000 ft. of 12 and 25 ft. of 8-in. pipe, connecting with pump well.

Pumping Machinery.—Dy. cap., 2,500,000 galls.; two 1,250,000 Deane, dup., direct-acting; a comp., with independent condenser, other high-pressure. *Boilers:* from Whittier Machine Co., Boston, Mass.

Distribution.—*Mains*, c. i., 14 miles. *Services*, galv. i., lead. Pipe and specials from Lake Shore Foundry, Cleveland, O. *Taps*, 760. *Meters*, Frost, 15. *Hydrants*, Chapman, 150. *Valves*, Chapman. *Pressure-recording gauge*, Edson.

Consumption, 750,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—Cost, $235,000. Cap. stock, $100,000. Bonded debt, $135,000. Int., 6%. Ann. op. exp., $5,500. Ann. rev.: consumers, $13,542, including $900 from 15 private hydrants; city, $9,650. Hydrant rental, $75 for first 70, $70 for next 50, $60 for additional.

Management.—Prest., W. A. Lynch, Canton, O. Secy., B. J. Brown. Treas., A. H. Howland, Boston, Mass. Supt., C. E. Inman.

MIDLAND, *Midland Co.* (Pop., 1,529; est., 2,000.) On Tittebawasee and Chippewa rivers, on high ground 20 miles from Saginaw. Manufactures lumber salt and bromine. Settled in '55; incorp. city in '68. Has sewers. No electric lights.

History.—Built in '82 by city. Engr. and Contr., M. Walker, Fenton.

Water Supply.—Chippewa river, by direct pumping.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; two Walker. *Boilers:* steel, tubular.

Distribution.—*Mains*, Wyckoff, 4⅔ miles. *Services*, w. i., lead, wood. *Taps*, 150. *Meters*, none. *Hydrants*, Holly, 32.

Consumption, 500,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—Cost, $22,000. Debt, $20,000. Int., 5%. Ann. op. exp., $2,600. Ann. rev.: consumers, $2,637; city, $133.

Management.—Secy., Wm. Reardon. Supt., Chas. Fournia.

MIO, *Oscoda Co.* (Pop., est., 500.) On Ausable river. Eugaged in lumbering.

History.—Built in '89 by Mio Water Co., principally for fire protection.

Water Supply.—Spring creek, pumping to reservoir.

Pumping Machinery.—No data.

Reservoir.—No data.

Distribution.—Mains, ½ mile.

Financial.—Cost, $4,000, paid up stock.

Management.—Secy. and Supt , Jno. Randall.

MONROE, *Monroe Co.* (Pop., 4,900; est., 6,500.) On Raisin river, 40 miles from Detroit, 20 from Toledo, O. Has manufactories. Ships grain. Incorp. city. No sewers or electric lights.

History.—Built in '89 by Monroe Water Co.; put in operation about Dec. 1, '89. Des. Engr., E. F. Fuller, N. Y. City. Const. Engr., Chester McFarland. Franchise

granted to W. S. Parker & Co., Pontiac, providing that city might buy works any time within 25 years, and that if it has not done so at end of that time value shall be fixed by appraisal and works then be bought by city.

Water Supply.—Lake Erie, direct pumping. Station about 1½ miles from city.

Intake.—Diam., 20 ins.; extends 2½ miles to crib in lake. [Subject to correction.] Laid by H. C. Thacher, Toledo, O.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two 1,500,000 Worthington comp., dup., cond. *Boilers*, from Ames Iron Works, Oswego, N. Y.

Distribution.—*Mains*, 20 to 4-in. c. i., 15 miles; from Lake Shore Foundry, Cleveland, O.; laid by Snyder & Williams, Dayton, O. *Hydrants*, Ludlow, 128.

Pressure: Ordinary, 80 lbs. Fire, 150 lbs.

Financial.—Cost, est., $150,000. Cap. stock, $50,000. Hydrant rental, $46.90.

Management.—Pres't., Geo. Spaulding. Secy., C. W. Scott. Treas., E. H. York. Portland, Me. Reports, Mar. 4, June 3, Sept. 14, '89.

MONTAGUE, *Muskegon Co.* (Pop., 1,950; est., 2,300.) On Lake Michigan. Engaged in lumbering.

General Description.—For fire protection. Pump in saw-mill. 1,800 ft. of pipe in principal street and 10 hydrants.

MOUNT CLEMENS, *Macomb Co.* (Pop., est., 4,500.) On Clinton river, at head of navigation, 25 miles from De roit. Has mineral springs. Incorp. Has sewers and electric lights.

History.—Built in '88 [probably], by Co. Des. Engr., Chester B. Davis, Chicago, Ill. Const. Engr., J. F. Whitmer.

Water Supply.—Clinton river, filtered, direct pumping.

Pumping Machinery.—Dy. cap., 2,000,000 galls; Blake.

Filter.—American.

Distribution.—*Mains*, 12 to 6-in., material not given, 4 miles. *Services*, not given. *Taps*, 129. *Meters*, 1. *Hydrants*, kind not given, 99.

Consumption, 175,000 galls. *Pressure*, 40 to 80 lbs.

Financial.—Cost, $49,358. Debt, $50,000. Int., 5%. Ann. op. exp., $3,000. Ann. rev.: consumers, $1,500; city, $4,950. Hydrant rental, $50 for first 100, $40 for additional.

Management.—Prest., Wm. Donaldson. Secy., Chas. Fitch. Supt., T. J Hoyt.

MOUNT PLEASANT, *Isabella Co.* (Pop., 1,115; est., 3,000.) On Chippewa river, on gently sloping ground about 20 ft. above river. Soil is sandy, underlaid by hardpan at depth of about 8 ft. Settled in '64; incorp. in '65. No sewers or electric lights.

History.—Built in '82-3 by village. Des. Engr., A. C. Sekell, Grand Rapids. All work done by day. In '88 there was large falling off in number of consumers, owing to report that water was unfit for use. This was partially true and measures were taken to better the supply.

Water Supply.—Well, pumping to tank and, in case of fire, direct. Well is 17½ ft. in diam. for 20 ft., then 6 ft. in diam. for 8 ft.; in bottom there are one 6, two 3 and one 2-in. driven wells. Less than half population is now supplied.

Pumping Machinery.—Dy. cap., 1,636,800 galls.; Deane water-power, 16-in. bore and stroke.

Force Main.—C. i., 8-in.

Tank.—Cap., 176,250 galls.; cedar, 20 x 16 ft.; 75 ft. above pumps, 45 above highest part of village.

Distribution.—*Mains*, c. i., 4½ miles. *Services*, w. i., lead. Mains and specials from Cincinnati & Newport Iron & Pipe Co., Newport, Ky.; lead pipe from Detroit Lead Pipe and Sheet Lead Works. *Taps*, 194. *Hydrants*, Ludlow, one Galvin, 28. *Valves*, Ludlow, Chapman, Galvin.

Consumption, 160,000 galls. *Pressure:* Ordinary, 25 lbs. Fire, 80 to 100 lbs.

Financial.—Cost, $45,500. Debt, $15,000. Int., 5%. Ann. op. exp., $1,525. Ann. rev.: consumers, $950.

Management.—Three Comrs. Secy., C. W. Churchill. Supt., Wm. Dixon.

MUSKEGON, *Muskegon Co.* (Pop., 11,262; est., 25,000.) On Muskegon river 6 miles from Lake Michigan. Has extensive lumber industries, hardware and machine shops, boiler works and furniture factories. Incorp. Has sewers and electric lights.

History.—Built in '74-5 by city. Engr., Geo. C. Morgan, Chicago.

Water Supply.—Well and branch of Muskegon river, direct pumping. Well is 30 ft. in diam., 15 ft. deep.

Pumping Machinery.—Dy. cap., 6,000,000 galls.; two Flanders, two 750,000 Walker, two Wolverine.

Distribution.—*Mains*, c. i., w. i., 25¾ miles. *Services*, galv. i. *Taps*, 1,300. *Meters*, none. *Hydrants*, Ludlow, Galvin, 302. *Valves*, Ludlow, Galvin. *Close of '80*: Mains, 16¾ miles, Taps, 625. Meters, none. Hydrants, 200.

Consumption, 1,300,000 galls. *Pressure:* Ordinary. 40 lbs. Fire, 85 lbs.

Financial.—Cost, $216,000. Debt, $110,000. Int., 8%. Sinking fund, $10,000 per year. Ann. op. exp., $12,590. Ann. rev.: consumers, $15,000; city, $18,000. Hydrant rental, $60. Cost, close '80, $114,736 Rev., '80, $7,147.

Management.—Secy., Jno. Koppenheimer. Supt., Wm. Dixon.

NEGAUNEE, *Marquette Co.* (Pop., 3,931; est., 6,000.) Engaged in iron mining. No sewers or electric lights.

History.—Built in '82-3 by city. Work done by day.

Water Supply.—Teal lake, by direct pumping. Lake is about 2 miles each way and 35 ft. deep, with muddy bottom.

Pumping Machinery.—Dy. cap., 800,000 galls.; two Worthington comp., 15-in. stroke, one Knowles. *Boilers:* two 4x16-ft., tubular.

Distribution.—*Mains*, 8 to 4-in., Wyckoff, 9 miles. *Services*, galv. i. *Taps*, 306 *Meters*, none. *Hydrants*, Holly, Galvin, 33.

Consumption, 300,000 galls. *Pressure:* Ordinary, 45 lbs. Fire, 60 lbs.

Financial.—Cost, $50,000. Debt, $20,000. Int., 3½% and 4%. Ann. op. exp., $5,837. Ann. rev.: consumers, $5,518.

Management.—Mayor and Common Council. Supt., A. Benishek.

NEWAYGO, *Newaygo Co.* (Pop., 1,097; est., 2,005.) On Muskegon river, which furnishes water-power. Engaged in lumbering and manufacturing.

History.—Built in '84 by village. Engr. and Contr., for all but buildings, M. Walker, Fenton.

Water Supply.—Well, by direct pumping.

Pumping Machinery.—Dy. cap., 750,000 galls.; two Walker.

Distribution.—(In '87.) *Mains*, Wyckoff. 1¼ miles. *Services*, galv. i. *Taps*, 24. *Meters*, none. *Hydrants*, Ludlow, 13. *Valves*, Ludlow.

Consumption, not given. *Pressure:* Ordinary, 40 lbs.

Financial.—(In '87.) Cost, $12,000. Debt, $10,000. Int. 6%. Ann. op. exp. in '86), $395. Ann. rev.: consumers (in '86), $242.

Management.—Common Council and Village Prest. Supt. (in '88), Wm. Bierbower.

NOTE.—No reply to inquiries sent in '89.

NILES, *Berrien Co.* (Pop., 4,197; est., 4,500.) On St. Joseph river on undulating ground. Has water-power and manufactories. Settled in '28; incorp. village in '38.

History.—Built in '78-9 by Niles Water-Works Co. Contr., S. L. Wiley, Omaha, Neb.

Water Supply.—Barren lake, by gravity to distributing reservoir.

Conduit.—From lake to reservoir, about 5 miles of 12-in. w. i. and cem.

Reservoir.—Cap., 300,000 galls.; 106 ft. above village.

Distribution.—*Mains*, w. i. and cem. 9 miles; partly from Ferris & Halladay, Jersey City, N. J. *Services*, galv. i. *Taps*, 300. *Meters*, none. *Hydrants*, Flower, 56.

Consumption (in '87), about 275,000 galls. *Pressure*, 45 lbs

Financial.—Cost (in '84), $45,000. Further data withheld, but est.: Ann. op. exp., $1,000. Ann. rev.: consumers, $6,000.

City annulled its hydrant contract of $50 rental, after having paid for several years, on ground that it had no right to make it. Co. offered to compromise at $25; city refused and in '88 or '89 Co. removed rods from hydrants, leaving city without fire protection.

Management.—Prest., S. L. Wiley, Omaha, Neb. Supt., Secy. and Treas., J. H. Richardson.

NOTE.—Above substantially as given in '88 MANUAL. Supt. reporting that there had been no change.

NORTH MUSKEGON, *Muskegon Co.* (Pop., not given, but small.) On Muskegon river, opposite Muskegon. Incorp. No sewers or electric lights.

History.—Built in '85-6 by village. Const. Engr. and Contr., A. L. Holmes, Grand Rapids.

Water Supply.—Rain lake and 30 2-in. driven wells, direct pumping.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; two Walker.

Distribution.—*Mains*, Wyckoff wood, 3½ miles. *Services*, iron. Pipe from Michigan Pipe Co., Bay City. *Taps*, 150. *Meters*, none. *Hydrants*, kind not given, 60.

Consumption, 250,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 80 lbs.

Financial.—Cost, $30,000. Debt, $23,000: $15,000 at 6, $8,000 at 5%. Ann. op. exp., $2,000. Ann. rev.: consumers, $1,000.

Management.—Comr. Supt., Wm. Collins.

OSCODA, *Iosco Co.* (Pop., 1,951; est., 7,000.) On Lake Huron, at mouth of Ausable river. Engaged in manufacturing salt and lumbering. Incorp. No sewers or electric lights.

History.—Built in '86 by village. Engr., H. N. Hewlett, present Supt. Contr., A. L. Holmes, Grand Rapids.

Water Supply.—Lake Huron, by direct pumping.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; two Blake, with 20 x 24-in. steam, 12-in. water cylinders. Two private pumps are also connected with system, and can be used for fire protection while mills are running. One is Worthington dup., 12 x 14-in. steam, 7-in. water cylinders; other, Blake, of 16 x 18-in. steam, 13-in. water cylinder.

Distribution.—*Mains*, Wyckoff, 4½ miles. *Services*, Wyckoff. Pipe and specials furnished and laid by Michigan Pipe Works, Bay City. *Taps*, 200. *Meters*, none. *Hydrants*, Holly, Gaskill, 61. *Valves*, Eddy.

Consumption, 250,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—Cost, $20,000. Bonded debt, $9,500. Int., 6%. Ann. op. exp., $3,000. Ann. rev.: consumers, $900. Balance of expense is made up by city by taxation.

Management.—Village Board. Secy., G. H. Cosgrove. Supt., H. N. Hewlett.

OTSEGO, *Allegan Co.* (Pop., 1,000; est., 1,800.) On Kalamazoo river. Has factories and foundries. Incorp. village. No sewers or electric lights.

History.—Built in '88 by village. Engr. and Contr., M. Walker, Fenton.

Water Supply.—Kalamazoo river, direct pumping.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; two Walker.

Distribution.—*Mains*, 8 to 4-in. c. i., 3 miles. *Taps*, 60. *Hydrants*, 20.

Consumption, not given. *Pressure:* Ordinary, 40 lbs. Fire, 180 lbs.

Financial.—Cost, $15,000. Debt, $8,000. Int., 6%. Ann. op. exp., withheld, est. $750. Ann. rev., withheld, est., $1,000.

Management.—Secy., Frank Millham. Supt., C. J. Chopp. Report, about Jan. 1, '90.

OVID, *Clinton Co.* (Pop., 1,479; est., 2,000). Engaged in manufacturing. Incorp. No sewers or electric lights.

History.—Built in '88 by village. Engrs. and Contrs., Michigan Pipe Co., Bay City, A. L. Holmes, Grand Rapids.

Water Supply.—Wells, by direct pumping.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Gordon & Maxwell.

Distribution.—*Mains*, Wyckoff, 3¼ miles. *Services*, Wyckoff wood. *Hydrants*, Holly, Gaskill, 32. *Valves*, Galvin.

Consumption, 100,000 galls. *Pressure*, not given.

Financial.—Cost, $15,000. Debt, $15,000. Int., 5%. Ann. op. exp., est., $2,400. Ann. rev.: not determined.

Management.—Supt., D. W. Moorhouse. Chief Engr., Geo. W. Wortman.

OWOSSO, *Shiawassee Co.* (Pop., 2,501; est., 5,000.) On Shiawassee river. Has various manufactories.

History.—Built in '89 by village. Engr., Jno. W. Hill, Cincinnati, O. Contr. for labor, M. H. Myers & Son, Hillsdale. Unofficially reported that Contr. abandoned work before completion, and that city carried it on.

Water Supply.—Wells or river (or both), direct pumping.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two Gordon comp., non-cond., dup., 12 and 8¼ x 12-in. steam, 10-in. water cylinders. *Boilers:* Gordon.

Distribution.—*Mains*, c. i., length not given (692 tons), est., 6 miles; from Addyston Pipe & Steel Co., Cincinnati. *Hydrants*, Bourbon, 66. *Valves*, Galvin.

Financial.—Cost, total of contract prices, $37,728.

Management.—Not given. Report, June 25, '89.

PETOSKEY, *Emmet Co.* (Pop., 1,815; est., 3,500.) On Bear river and Little Traverse bay, Lake Michigan. Manufactures lime, leather and woodenware. Incorp. No sewers. Has electric lights

History.—Built in '81 by village. Des. Engr., W. R. Coats, Kalamazoo.

Water Supply.—Well, 50 ft. from Traverse bay, pumping direct, and to tank for fire protection.

Pumping Machinery.—Dy. cap., 200,000 galls.; Knowles water-power, 12 x 24 ins.

Tank.—Cap., about 100,000 galls.; iron, on high ground at east end of village, 210 ft. above pumps.

Distribution.—*Mains*, c. i., wood, 2 miles. *Services*, iron. *Taps*, 200. *Meters*, none. *Hydrants*, Mathews, Holly, 14.

Consumption, 100,000 galls. *Pressure:* 40 to 80 lbs.

Financial.—Cost, $22,000. Debt, $16,000. Int., 5% Ann. op. exp., $700. Ann. rev: consumers, $1,500.

Management.—Supt., G. S. Richmond.

PINCONNING, *Bay Co.* (Pop, 738; est., 1,200.) Is 19 miles from Bay City Incorp. Partially sewered. No electric lights.

History.—Built in '88 and put in operation Jan. 1 '89, by village. Engrs. and Contrs., Michigan Pipe Co., Bay City; A. L. Holmes, Grand Rapids.

Water Supply.—Artesian well, by direct pumping.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Smith & Vaile.

Distribution.—*Mains*, 8 to 4-in. Wyckoff wood, 1¼ miles. *Taps*, 11. *Hydrants*, Holly-Gaskill, 15. *Valves*, Galvin.

Consumption, 50,000 galls. *Pressure*, not given.

Financial.—Cost, $7,000. Debt, $8,000. Int., 7%. Sinking fund, $500. Ann. op. exp., est., $900. Ann. rev.: not determined.

Management.—Prest., D. McDougall. Secy. Geo. Barie.

PLAINWELL, *Allegan Co.* (Pop., 1,356; est., 1,800.) On Kalamazoo river on nearly level ground. Has water-power used in manufacturing flour, paper and woodenware. Settled in '60; incorp. in '68. No sewers or electric lights.

History.—Built in '70 and extended in '85, by village. Water not used for domestic purposes. **Water Supply.**—Kalamazoo river, by direct pumping. **Pumping Machinery.**—Dy. cap., 400,000 galls.; Walker; formerly Holly rotary. **Distribution.**—*Mains*, c. i., Wyckoff, 3 miles. *Services*, w. i. *Taps*, 86. *Meters*, none. *Hydrants*, Holly, 28. *Valves*, Holly. *Consumption*, 200,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 80 lbs. **Financial.**—Cost, $14,010. No debt. Ann. op. exp., $240. Ann. rev.: consumers, $86; city, $410. **Management.**—Supt., J. M. Sternberg.

PONTIAC, *Oakland Co.* (Pop., 4,509; est., 6,000.) On Clinton river 26 miles from Detroit. Incorp. Partially sewered. Has electric lights.

History.—Built in '88 by town. Des. Engr., J. D. Cook, Toledo, O. Const. Engr., Harvey E. Monroe. Contrs., W. S. Parker & Co., N. Y. City.

Water Supply.—Clinton river and wells, direct pumping.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two 1,500,000 Worthington, comp., dup., non-cond.

Distribution.—*Mains*, 16 to 4-in. c. i., 13 miles. *Services*, lead, iron. Pipe and specials from New Philadelphia (O.) Pipe Works. *Taps*, 175. *Meters*, none. *Hydrants*, Mathews, 115. *Valves*, Ludlow.

Consumption, 65,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—Cost, $85,000. Bonded debt, $85,000. Int. 4½%. Ann. op. exp., $3,300. Ann. rev.: consumers, $2,000; city, $7,475. Hydrant rental, $65.

Management.—Comrs. Secy., Fred Van Hoven. Supt., Harvey G. Monroe.

PORT HURON, *St. Clair Co.* (Pop., 8,883; est., 13,500.) At junction of St. Clair and Black rivers, one mile from Lake Huron. Engaged in lumbering, ship building and commerce. Settled in '28; incorp. city in '59. Has sewers and electric lights.

History.—Built in '72 by city. Des. Engr., Wm. H. Avery.

Water Supply.—Lake Huron, by direct pumping.

Pumping Machinery.—Dy. cap., 8,000,000 galls.; 3,000,000 Holly quadruplex, 5,000,000 Gaskill horizontal. Small Perkins pump has been used.

Distribution.—*Mains*, 20 to 2-in. c. i., Wyckoff, 29 miles. *Services*, w. i., lead. *Taps*, 1,950. *Meters*, none. *Hydrants*, Holly, 147. *Valves*, Flower.

Consumption, 1,834,751 galls. *Pressure:* Ordinary, 30 lbs. Fire, 78 lbs.

Financial.—Cost, $239,786. Debt, $120,000. Int., 5%. Ann. op. exp., $9,313. Ann. rev.: consumers, $21,512. Rev., '73, $727; do., '80, $9,080.

Management.—Three Comrs. Secy. and Treas., L. Atkins. Chief Engr., H. F. Doran.

PORTLAND, *Ionia Co.* (Pop., 1,670; est., 2,000.) At junction of Grand and Looking Glass rivers. Has water-power and manufactories.

General Description.—Built in '79 by village. Line of Wyckoff wood pipe is laid through business street for about 1,200 ft., on which there are 3 hydrants. Pump is used for fire protection, giving pressure of 80 lbs. Village Trustee, W. F. Selleck.

NOTE.—Unofficially reported in '89 that Portland Water Co. had been incorp., and would build works; also that contract for stand-pipe had been let to Porter Mfg. Co., Syracuse

QUINNESEC, *Menominee Co.* (Pop., est., 500.)

General Description.—Built in '86 by town. Knowles pump lifts water from mine to two tanks, from which about one mile of Wyckoff wood pipe distributes it. There are 2 taps and 5 hydrants. Cost, $2.500. No debt. Ann. op. exp., $200. No rev. Supervisor, Thos. McKenna.

RED JACKET, *Houghton Co.* (Pop., 2,140; est., 5,000.) Mining center.

History.—Built by Calumet & Hecla Mining Co., date not given.

Water Supply.—Lake Superior, 4 miles distant, pumping to stand-pipe.

Financial.—Cost, $50,000.

Management.—Rest. Supt., of above Co., J. N. Wright, Calumet.

NOTE.—No further data could be obtained.

REED CITY, *Osceola Co.* (Pop., 1,091; est., 2,500.) On Hersey river on rolling ground. Has water-power, planing mills and foundries and various manufactures. Settled in '72; incorp. in '75. No sewers or electric lights.

History.—Built in '82 by village. Engrs. and Contrs., E. G. Studley & Co., Grand Rapids.

Water Supply.—Well, 20 ft. in diam., spring, Hersey creek, direct pumping.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Deane.

Distribution.—*Mains*, Wyckoff, 2 miles. *Services*, w. i Pipe and specials furnished and laid by Mich. Pipe Co., Bay City. *Taps*, 150. *Meters*, none. *Hydrants*, kind not given, 19.

Consumption, 200,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 90 lbs.

Financial.—Cost, $14,000. Bonded debt, $4,000. Int., 6%. Ann. op. exp., $1,500. Ann. rev.: consumers, $1,200; city, $300.

Management.—Comrs. Secy., L. B. Winsor. Supt., B. F. Edwards.

ROSCOMMON, *Roscommon Co.* (Pop., 114; est., 500.)

History.—Built in '83 by town. Engrs. and Contrs., Flint, Walling & Co., Kendallville, Ind.

Water Supply.—Spring creek, pumping to tank.

Pumping Machinery.—Dy. cap., not given; two Deane, one of which is direct-acting, driven by windmill.

Tank.—Cap., 45,500 galls.; wood, 22 x 16 ft.

Distribution.—(In '87.) *Mains*, Wyckoff wood, 1 mile; from Mich. Pipe Co., Bay City. *Services*, iron. *Taps*, 25. *Meters*, none. *Hydrants*, kind not given, 15.

Consumption (in '87), 10,000 galls. *Pressure*, 40 lbs.

Financial.—(In '87.) Cost, $7,500. No debt. Ann. op. exp., $200. Ann. rev.: consumers, $75; city, $125.

Management.—(In '88.) Com. of three. Supt., Jno. R. Cady. Report by H. H. Woodruff, one of Com.

SAGINAW, *Saginaw Co.* (Pop., 10,525; est., 18,000.) On Saginaw river, at head of navigation, 22 miles from its mouth. On level ground. Engaged in lumber and salt trade. Settled in '22. Incorp. city in '57. Has sewers and electric lights.

History.—Built in '72 by City. Des. Engrs., Holly Mfg Co., Lockport, N. Y.

Water Supply.—Saginaw river, by direct pumping

Pumping Machinery—Dy. cap., 12,000,000 galls.; Gaskill; 4,000,000 horizontal, 8,000,000 vertical triple, comp.; latter added in '89. Original pumps, 2,000,000 Holly quadruplex, 9 x 24 ins.; two 10-in. Holly rotary, for fire pressure. *Boilers:* two 120-H. P., steel, were added in '89.

Distribution.—*Mains*, c. i., Wyckoff, 16½ miles. *Services*, w. i., lead. *Taps*, 450. *Meters*, none. *Hydrants*, Holly, 207. *Valves*, Galvin.

Consumption, 2,800,000 galls. *Pressure:* Ordinary, 42 lbs. Fire, 95 lbs.

Financial.—Cost, $205,000. Debt, $135,000: $50,000 at 8, $25,000 at 5½, $20,000 at 5, and $40,000 at 4½%. Ann. op. exp., $7,000. Ann. rev.: consumers, $6,000; city, $15,000, Hydrant rental, $35.

Management.—Water Board. Prest., A. Barnard. Secy. and Controller, Wm. Binder. Supt., H. F. Allen.

SAINT CLAIR, *St. Clair Co.* (Pop., 1,923; est., 3,200.) At junction of St. Clair and Pine rivers. Has manufactories.

History.—Built in '86 by village. Contr. for all but buildings, M. Walker, Fenton.

Water Supply.—St. Clair river, direct pumping.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; two Walker.

Distribution.—(In '87.) *Mains*, kal. i., 6¾ miles. *Services*, galv. i. *Taps*, 221. *Meters*, none. *Hydrants*, Ludlow, 46. *Valves*, Ludlow.

Consumption (in '87), 300,000 galls. *Pressure:* Ordinary 40 lbs. Fire, 90 lbs.

Financial.—(In '87.) Cost, $32,500. Bonded debt, $32,500. Int., 5½%. Ann. op. exp., $2,000. Ann. rev.: consumers, $3,100.

Management.—(In '88.) Prest. Water Board, Thos. J. Milliken. Secy., and Supt., W. B. Morse.

NOTE.—No reply to inquiries sent in '89.

SAINT IGNACE, *Mackinac Co.* (Pop., 966; est., 3,500.) On Straits of Mackinac, Lake Huron. Has iron smelting works. Incorp. city. No sewers or electric lights.

History.—Built in '89 by city; put in operation Dec. 13. Engr. and Contr., Geo. C. Morgan, Chicago.

Water Supply.—Lake Huron, pumping to stand-pipe.

Intake.—Extends 400 ft. into lake; diam., not given.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two Deane. *Boilers:* from National Boiler Works, Chicago.

Stand-Pipe.—Cap., about 50,000 galls.; 12 x 60 ft.; enclosed by wooden building; on elevation about 100 ft. above lake.

Distribution.—*Mains*, 12 to 4-in. c. i., 4¼ miles. *Hydrants*, Morgan, 39.

Financial.—Cost, $36,409. Debt, $40,000. Int., 5%.

Management.—Water Board. Prest., Wm. Saulson. Secy., P. W. Murray. Supt., W. J. Kentworthy. Latest report, Jan. 9, '90.

SAINT JOHN'S, *Clinton Co.* (Pop., 2,370; est., 4,000.) Has manufactories. Incorp. village in '67, with amendments since. No sewers. Has electric lights.

History.—Built in '89 by village; put in operation about Oct. 15, '89. No Engr. Contrs., A. Harvey & Son, Detroit.

Water Supply.—Artesian wells, pumping direct.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; Gordon dup. *Boilers:* Gordon.

Reservoirs.—Cap., 150,000 galls.; two, 75,000 galls. each.

Distribution.—*Mains*, 10 to 4-in. c. i., 3 miles; from Addyston Pipe & Steel Co., Cincinnati, O. *Hydrants*, Galvin, 79. *Valves*, Galvin.

Financial.—Cost, about $46,000. Bonded debt, $45,000; due Oct. 1, 1914. Int., 5%

Management.—Village Clerk, Chas. P. Baker. Supt., Peter E. Wellsworth. Latest report, Sept. 9, '89.

SAINT LOUIS, *Gratiot Co.* (Pop., 1,975; est., 3,600.) On Pine river, 30 miles west of Saginaw. Has water-power. Settled in '58; incorp. in '70. Has electric lights.

History.—Built in '80 by village. Des. Engr., Jno T. Noble, St. Louis. Const. Engr. and Contr. for all but buildings, M. Walker, Fenton.

Water Supply.—Two flowing wells, direct pumping. Water formerly taken from Pine river.

Reservoir.—Is 30 ft. wide, 16 ft. deep.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; 750,000 Walker, two Holly water-power.

Distribution.—(In '87.) *Mains*, Wyckoff, about 5 miles. *Services*, Wyckoff, lead, w. i. Pipe from Mich. Pipe Co., Bay City. *Taps*, 117. *Meters*, 1. *Hydrants*, Holly, 32. *Valves*, Holly.

Consumption, not given. *Pressure:* Ordinary, 45 lbs. Fire, 85 lbs.

Financial.—(In '87.) Cost, $20,000. Bonded debt, $4,000. Int., 4%. Ann. op. exp., $400. Ann. rev.: consumers, $1,800.

Management.—(In '88.) Water Board. Chn., C. W. Giddins. Supt., Jno. T. Noble.

NOTE.—No reply to inquiries sent in '89.

SAND BEACH, *Huron Co.* (Pop., 334; est., 1,500. On Lake Huron at U. S. Harbor of Refuge, on level ground. Manufactures dairy salt, flour, lime and lumber. Settled in '50; incorp. village in '82. No sewers or electric lights.

History.—Built in '81 by J. Jenks & Co., for fire protection. **Water Supply.**—Lake Huron, by direct pumping. **Pumping Machinery.**—Dy. cap., 1,500,000 galls.; Deane. **Distribution.**—*Mains.* Wyckoff wood, 3 miles. *Taps,* 10. *Meters,* none. *Hydrants,* Holly, 12. *Consumption,* 5,000 galls. *Pressure,* not given. **Financial.**—Cost, $5,000. No debt. Ann. op. exp., $1,500. No rev. **Management.**—Prest., J. Jenks. Secy. and Treas., B. Jenks. Supt., J. G. Pudoch.

SAULT DE STE. MARIE, *Chippewa Co.* (Pop., 1,949; est., 10,000.) On Sault Ste. Marie river. Engaged in manufacturing lumber and in trade. Incorp. city. Has sewers and electric lights.

History.—Built in '68 by city. Const. Engr., H. H. Harrison, Stillwater, Minn.

Water Supply.—Sault Ste. Marie river, direct pumping.

Pumping Machinery.—Dy. cap., 1,500,000 galls; two Walker. *Boilers:* Walker.

Distribution.—*Mains,* 12 to 4-in. w. i., 6 miles; from National Tube Works, McKeesport, Pa. *Services,* not given. *Taps,* 450. *Meters,* not given. *Hydrants,* 50.

Consumption, 300,000 galls. *Pressure:* Ordinary, 35 lbs. Fire, 75 to 90 lbs.

Financial.—Cost, $50,000. Debt, $50,000. Int., 6%. Ann. op. exp., $4,500. Ann. rev., total, $5,500.

Management.—Mayor (June '89), Otto Fowle. Report, June 28, '89.

SHERIDAN, *Montcalm Co.* (Pop. 661; est., 600.) Engaged in lumbering.

History.—Built in '82 by village, for fire protection. **Water Supply.**—Pearl lake, by direct pumping. **Pumping Machinery.**—Dy. cap., not given; Blake. **Distribution.**—*Mains,* Wyckoff wood, ½ mile. *Hydrants,* 4. *Pressure:* 50 to 100 lbs. **Financial.**—(In '87.) Cost, $3,500. No debt. Ann. op. exp., $180 No rev. **Management.** -(In '88) Village Clerk, J. P. Canlee.

STANTON, *Montcalm Co.* (Pop., 1,760; est., 1,800.) Incorp. Partially sewered. No electric lights.

History.—Built in '85 by village. Engrs. and Contrs., Mich. Pipe Co., Bay City.

Water Supply.—Flowing well, 8-in., pumping to reservoirs.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; two Walker.

Reservoirs.—Two: one 45 x 22 ft., x 10 ft. deep; other, circular, 16 ft. diam. x 12 ft. deep.

Distribution.—*Mains,* wood, 2 1-6 miles. *Services,* lead. *Taps,* 113. *Meters,* none. *Hydrants,* kind not given, 32.

Consumption, est., 100,000 galls. *Pressure:* Ordinary, 50 lbs. Fire, 120 lbs.

Financial.—Cost, $15,094. Debt, $7,000, Int., 6%. Ann. exp., $1,500. Ann. rev.: consumers, $950.

Management.—Clerk, A. G. Miller. Comr., Max Jennings.

STURGIS, *St. Joseph Co.* (Pop., 2,060; est., 3,000.) Has manufactories. Incorp. village. No sewers. Has electric lights.

History.—Built in '89 by city; put in operation Dec. 1. Des. Engr., Geo. H. Chandler, Kalamazoo. Const. Engr. and Contr., Geo. C. Morgan, Chicago, Ill.

Water Supply.—Well, direct pumping.

Pumping Machinery.—Dy. cap., 1,750,000 galls.; two 875,000 Gordon.

Distribution.—*Mains,* 10 to 4-in. c. i., 6 miles; from Lake Shore Foundry Co., Cleveland. *Services,* galv. i. *Taps,* about 100. *Meters,* none. *Hydrants,* Galvin, 56. *Valves,* Galvin.

Pressure: Ordinary, 45 lbs. Fire, 110 lbs.

Financial.—Cost, $30,000. Debt, $30,000. Int., 5%.

Management.—Village Prest., Martin E. Aulsbrook. Secy. and Supt., Wm. S. Bunn. Report, Jan. 6, '90.

TECUMSEH, *Lenawee Co.* (Pop., 2,111; est., 2,500.) Has manufactories.

History.—Built in '77 by village. Contr., E. Wilson, Tecumseh.

Water Supply.—Well, pumping to tank. Well is 8 ft. diam., 40 ft. deep.

Pumping Machinery.—Dy. cap., 20,000 galls.; Perkins windmill driving force pump

Tanks.—Cap., 160,000 galls.; two, about 80,000 galls, each.

Distribution.—*Mains*, Wyckoff, ¾ mile. *Services*, lead. *Taps*, 5. *Meters*, none. *Hydrants*, Ludlow, 15. *Valves*, Ludlow.

Consumption, unknown. *Pressure*, 40 lbs.

Financial.—Cost, $7,000. No debt. Ann. op. exp., $150. Ann. rev.: consumers, $50.

Management.—Chf. Fire Dept., S. W. Bordine. Village Prest., Geo. Heesen.

THREE RIVERS, *St. Joseph Co.* (Pop., 2,525; est., 3,500.) On St. Joseph river at its confluence with Portage and Rocky rivers. Has water-power and various manufactories. Incorp. No sewers. Has electric lights.

History.—Built in '82 by village. Contrs. for all but buildings, M. Walker, Fenton.

Water Supply.—Nine 4-in. driven wells, 96 ft. deep, direct pumping.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; two Walker.

Distribution.—*Mains*, c. i., 4½ miles. *Services*, lead. *Taps*, 194. *Meters*, none. *Hydrants*, Holly, Chapman, 48. *Valves*, Holly, Chapman.

Consumption, 130,000 galls. *Pressure:* Ordinary, 35 lbs. Fire, 85 lbs.

Financial.—Cost, $35,000. Debt, $18,000. Int., 5%. Ann. op. exp., $500. Ann. rev.: total, $1,300.

Management.—Secy., H. D. Cushman. Pumping Engr., E. Bergert.

TRAVERSE CITY, *Grand Traverse Co.* (Pop., 1,897; est., 4,000.) At head of Grand Traverse Bay, Lake Michigan. Has foundries, saw, planing and flouring mills. Not incorp. Has sewers and electric lights.

History.—Built in '81-2 by H. D. Campbell.

Water Supply.—Grand Traverse bay, by direct pumping from settling basin.

Intakes.—Two 10-in. pipes extend from settling basin 500 ft. into bay to 20 ft. of water.

Settling Basin.—Brick, 16 ft. in diam. Sunk on V-shaped wooden shoe into 12 ft. of water.

Pumping Machinery.—Dy. cap., 2,500,000 galls.; two Walker, combined cap., 1,500,000 galls., with 14 x 12-in. steam, 8½-in. water cylinders. In '89 pump was added; no data.

Distribution.—*Mains*, Wyckoff, 6 miles. *Services*, galv. i. *Taps*, 242. *Meters*, 4. *Hydrants*, Flower, Galvin, 48. *Valves*, Flower, Galvin.

Consumption, 250,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 60 lbs.

Financial.—Cost, $35,000. Debt, withheld. Ann. op. exp., $2,400. Ann. rev.: consumers, $3,000; city, $3,180. Hydrant rental, first 18, $100; balance, $50.

Management.—Owner, H. D. Campbell. Supt., Donald F. Campbell.

VASSAR, *Tuscola Co.* (Pop. 670; est., 2,500.) On Cass river, 18 miles from Saginaw and 22 from Bay City. Manufactures lumber. Incorp. No sewers. Has electric lights.

History.—Built in '88 by village; put in operation Jan. 1, '89. Des. Engr., W. S Parker. Const. Engr., and Contrs, Michigan Pipe Co., Bay City; A. L. Holmes, Grand Rapids.

Water Supply.—From 6-in. artesian well and Cass river, pumping to standpipe and direct.

Pumping Machinery.—Dy. cap., 1,500,000 galls. Gaskill dup. *Boilers:* from Wickes Bros, E Saginaw.

Stand-Pipe.—Cap., 106,000 galls.; 15 x 80 ft.

Distribution.—*Mains*, 10 to 4-in. Wyckoff, 5½ miles. *Hydrants*, Mathews, from R. D Wood & Co. *Valves*, Galvin.

Consumption, not determined. *Pressure:* Ordinary, 75 lbs. Fire, 160 lbs.

Financial.—Cost, $29,000. Debt, 29,000. Int., 5%. Ann. op. exp. and rev., not determined.

Management.—Secy., H. A. Miller. Supt., F. L. Fales.

WEST BAY CITY, *Bay Co.* (Pop., 6,397; est., 12,500.) Near Bay City. Incorp. Has sewers and electric lights.

History.—Built in '89-3 by city. Engr., E. S. Van Liew.

Water Supply.—Saginaw river, by direct pumping.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two 1,500,000 Gaskill horizontal. *Boilers:* 5 x 14 ft.

Distribution.—*Mains*, c. i., Wyckoff. 13 miles. *Services*, wood, lead, w. i. Pipe from Michigan Pipe Co., Bay City; laid under direction of Water Board. *Taps*, 300. *Meters*, 1. *Hydrants*, Galvin, Flower, Ludlow, Bailey, 111.

Consumption, 700,000 galls. *Pressure:* Ordinary, 45 lbs. Fire, 115 lbs.

Financial.—Cost, $75,000. No debt. Ann. op. exp., $6,000. Ann. rev.: consumers, $2,500; city, $7,170.

Management.—Prest., Thom. Toohey. Supt., Secy. and Treas., W. H. Phillips.

WHITE CLOUD, *Newaygo Co.* (Pop., 440; est., 1,000.) On White river. Manufactures lumber and shingles. Railroad center. Incorp. No sewers or electric lights.

History.—Built in '86 by village. Engrs. and Contrs., Mich. Pipe Co., Bay City; A. L. Holmes, Grand Rapids.

Water Supply.—White river, by direct pumping.

Pumping Machinery.—Dy. cap., 25,000 galls.; kind not given.

Distribution.—*Main* , Wyckoff, 1 mile. *Services*, not given. *Taps*, 116. *Meters*, none. *Hydrants*, kind not given, 9.

Consumption, 10,000 galls. *Pressure:* 40 to 75 lbs.

Financial.—Cost, $10,500. Debt, $1,500. Int., 7%. Ann. op. exp., $500. Ann. rev.: consumers, about $300.

Management.—Secy., L. D. Sidebottom. Supt., G. W. Oaks.

WYANDOTTE, *Wayne Co.* (Pop., 3,631; est., $5,000. On Detroit river, 12 miles from Detroit. Has furnaces, rolling mills and other manufactories. Incorp. city. No sewers. Electric lights projected.

History.—Built in '89-90 by city; tested Jan. 25. Engr., J. D. Cook, Toledo, O.

Water Supply.—Detroit river, direct pumping.

Pumping Machinery.—Dy. cap. 3,000,000 galls.; Hughes. *Boiler:* Hughes.

Distribution.—*Mains*, 16-in. down, 8 miles; from Addyston Pipe & Steel Co., Cincinnati, O. *Hydrants*, Galvin, 85. *Valves*, Galvin.

Financial.—Cost, about $50,000. Debt., $50,000. Int., 5%.

Management.—Water Board. Prest., T. J. Langlois. Secy., J. S. McLaughlin, Jr. Supt., H. N. Ocobock. Reports, Sept. 18, '89, March 4, '90.

YPSILANTI, *Washtenaw Co.* (Pop., 1,459; est., 7,000.) On Huron river. Has water-power and manufactories. Incorp. city. Sewers projected for '90. Has electric lights.

History.—Built in '89 by city; put in operation about Dec. 1. Engr., W. R. Coats, Kalamazoo. Labor done by the day.

Water Supply.—Well, pumping to elevated tank. Well 30 ft. in diam., 30 ft. deep, sunk into drift gravel.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; from Flowers Bros., Detroit; triplicate, water-power.

Tank.—Cap., 254,000 galls.; 40 x 27 ft.; covered. Tank supported by masonry tower 90 ft. high; walls, 3 ft. thick at bottom, 2 at top, on footing walls 6 to 4 ft. thick. Tank rests on 10-in. steel beams, with masonry wall carried up flush with top. A second tank on opposite side of town, is included in plan and may be built in the future. Tank from Porter Mfg. Co., Syracuse.

Distribution.—*Mains*, 16 to 4-in., 17½ miles; from Detroit Pipe & Foundry Co. *Services*, galv. i. *Taps*, about 500. *Meters*, Worthington, 1. *Hydrants*, Flowers, 132. *Valves*, Flowers.

Consumption, est., 500,000 galls. *Pressure*, 95 lbs.

Financial.—Cost, $140,000. Bonded debt, about $125,000. Int., 4%.

Management.—Comrs. Prest., Danl. L. Quirk. Clerk, Frank Joslyn. Report, near close of '89.

Reference.—For detailed description, with illustrations, see *Eng. News*, vol. XXIII., May 5, *et seq.*

Water-Works Projected with Fair Prospects of Construction.

COLDWATER, *Branch Co.* (Pop., 4,681; est., 6,000.) On Coldwater river. Has electric lights.

Proposed Works.—Apr. 9, '90, people voted to issue $70,000 of bonds for works. Supply, well 80 ft. deep, carried below clay stratum, by pumping. Est. cost, $75,000. Mayor, C. D. Randall. Secy. Com., A. J. Pratt. Latest reports, Mar. 5 and Apr. 9, '90.

ELK RAPIDS, *Antrim Co.* (Pop., 741; est., 1,200.) On Grand Traverse bay. Has various manufactories.

Proposed Works.—M. B. Long wishes to build. Supply, Elk lake, by pumping. Est. cost., $2,500.

FRANKFORT, *Benzie Co.* (Pop., 782; est., 1,500.) Engaged in lumber and iron industries.

Proposed Works.—Town has appointed Comrs. and voted bonds to build works costing not above $10,000. See MANUAL for '88, p. 365. Report, March 14, '90.

IRON MOUNTAIN, *Menominee Co* (Pop , est., 7,500) Engaged in mining. Has electric lights.

Proposed Works.—Town to grant franchise to Co. Works to be completed by Nov '90 Supply, Quinnesec Falls springs, pumping to reservoir or stand-pipe. Proposed source, 2½ miles from city. Mains, 12 to 4-in. Hydrants, 75 to 80 Chn. Com , Jos. H. Sandercock. Latest report, Feb. 10, '90.

ROMEO, *Macomb Co.* ((Pop., 1,629; est., 2,000.) Has manufactories.

Proposed Works.—Jan. 3, '90, matter depended upon special election. Supply, Cusic lake, 2¼ miles from village, pumping to stand-pipe. Est. cost, $45,000 to $50,000; 30-years village bonds proposed. Unofficially reported, Mar., '90, that project had been defeated, and a few days later, that another vote would be taken. Village Clerk, B. N. Seaman.

Water-Works Projects Reported in '89 and 90, but now Indefinite.

Eaton Rapids, Eaton Co. *Huron*, Huron Co. *Nashville*, Barry Co. *Northville*, Wayne Co.

ILLINOIS.

Water-Works Completed or in Process of Construction.

ALEDO, *Mercer Co.* (Pop., 1,492; est., 2,000.) Incorp. city. No sewers or electric lights.

History.—Built in '89 by city. Engrs. and Contrs., U. S. Wind Engine & Pump Co., Batavia.

Water Supply.—Artesian well, pumping to tank. Well, 3,133 ft., tubed to draw either 1,200 or 3,000 ft. from surface; water from former depth rises within 60 ft. of surface, that from latter depth is mineral, and rises within 26 ft. of surface.

Pumping Machinery.—Dy. cap., about 75,000 galls.; Cook deep-well.

Tank.—Cap., 45,000 galls.; 18 x 24 ft.

Distribution.—*Mains*, 6-in. c. i., 1 mile. *Hydrants*, Eclipse, 8. *Valves*, Ludlow. *Pressure*, 40 lbs.

Financial.—Cost, $22,000: well, $14,000; remainder, $8,000. Debt, $16,000. Int., 5%. Ann. op. exp., est., $800.

Management.—City Clerk, S. D. C. Hays.

ALTON, *Madison Co.* (Pop., 8,975; est., 12,000.) On Mississippi river, 4 miles above mouth of Missouri river, and 25 from St. Louis, Mo.; divided near center by Pisa creek, from which and river ground rises rapidly, the highest elevation being 224½ ft. Engaged in river trade and manufacturing. Town laid out in '17. Incorp. Partially sewered. Has electric lights.

History.—Built in '75 by private company, name not given. Eng., Harry Taylor.

Water Supply.—Mississippi river, pumping to tanks and direct.

Intake Conduit.—To pump-well. Stone masonry in cem., 2 x 5 ft.

Filter.—Iron box, with capacity of 54 cu. ft., perforated with holes and filled with sponge. Box is raised by crane and sponges washed when necessary.

Pumping Machinery.—Dy. cap., 5,000,000 galls.; Deane horizontal, dup., high pressure; 1,500,000 Worthington. In '89, 2,500,000 pumping engine, from E. P. Allis & Co., was added; cost, about $30,000.

Tanks.—Cap., above 300,000 galls.; of wood, one 40 ft. diam. x 24 ft. high, and one 32 ft. in diam. x 16 ft. high. They are placed about 30 ft. above highest land in the city, and 260 ft. above pumps. In '89 an iron tank, costing $12,000, was erected; cap. not given.

Distribution.—*Mains*, c. i., 16 miles. *Services*, w. i., lead. *Taps*, 250. *Meters*, 46. *Hydrants*, kind not given, 97.

Consumption, 1,200,000 galls. *Pressure:* Ordinary, 85 lbs. Fire, 110 lbs.

Financial.—Cost, $110,000. Cap. stock, $200,000; increased in '89 from $150,000. Debt (in '87), $46,000. Int., 6%. Ann. op. exp., $10,000. Ann. rev.: $12,000; city, $9,000.

Management.—Prest., T. A. Taylor. Secy , W. A. Underwood. Supt., W. G. Curtis.

AURORA, *Kane Co.* (Pop., 11,873; est., 20,000.) On Fox river, 28 miles from Chicago. Has various manufactories. Incorp. city in '87. Partially sewered. Has electric lights.

History.—Built in '85 by city. Engr., Chester B. Davis, Chicago, Ill., with J. C. Des Granges as Asst. Engr. Contrs., Jas. H. Harlow & Co., Pittsburgh, Pa.

Water Supply.—Fox river, through galleries beneath river and island, pumping to stand-pipe and direct. Unofficially reported in '89 that a filter basin in 3 compartments was under construction.

Pumping Machinery.—Dy. cap., 4,000,000 galls.; Deane. *Boilers:* two, 2 x 16-ft., tubular.

Stand-Pipe.—Cap., 291,160 galls.; 18 x 153 ft.; from Water & Gas Construction Co., Pittsburgh, Pa.

Distribution.—*Mains*, c. i., 24½ miles. *Services*, lead. Pipe from Cincinnati & Newport Iron & Pipe Co., Newport, Ky.; specials from Union Foundry & Pullman Car Wheel Works, Chicago; trenching and pipe-laying done by B. E. Hattersley, Ft. Wayne, Ind. *Taps*, 1,050. *Meters*, 125. *Hydrants*, Ludlow, 250. *Valves*, Ludlow. *Pressure-recording gauge*, Edson.

Consumption, 450,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 100 lbs.

Financial.—Cost, $188,080. Debt, $138,000. Int., 5%. Ann. op. exp., $4,413. Ann. rev.: consumers, $9,070.

Management.—Board Public Works. Chn., C. C. Earle. Clerk, J. M. Kennedy. Supt., M. W. Corbett.

AUSTIN, *Cook Co.* (Pop , 1,359; est., 5,000.) Is 6 miles from Chicago.

NOTE.—Either supplied from, or project on foot to supply from, Oak Park water-works.

BARRY, *Pike Co.* (Pop., 1,392; est , 1,700.) Manufactures flour, woolen goods, and packs pork.

History.—Built in '80-1 by village. Labor done by day.

Water Supply.—Artesian well, 2,510 ft. deep, pumping to tank.

Pumping Machinery.—Dy. cap., not given; from Smith, Hill & Co , Quincy.

Tank.—Cap., 47,000 galls.; 20 x 20 ft.; at elevation of 50 ft.

Distribution.—(In '87.) *Mains*, 6-in. c. i., about 1 mile. *Services*, iron. *Taps*, 20. *Meters*, none *Hydrants*, Ludlow, 8.

Consumption (in '87,), 6,000 galls. *Pressure*, 20 lbs.

Financial.—(In '87.) Cost, $13,000. Debt, $800. Int., 8%. Ann. op. exp., $200. Ann. rev.: consumers, $150.

Management—(In '88) Village Council. Mayor, B. McConnell.

NOTE—No reply to inquiries sent in '89.

BELLEVILLE, *St. Clair Co.* (Pop., 10,683; est., 17,000.) Is 14 miles from St. Louis, Mo. Manufactures nails, oil, stoves, pumps, and glass. Partially sewered. Has electric lights.

History.—Built in '85 by City Water Co. Engr., S. H. Lockett. Contrs., Comegys & Lewis. Both of N. Y. City.

It was unofficially reported Dec. '89, that a suit had been begun by the American Loan & Trust Co. of N. Y. City to foreclose a mortgage on all the property of the Co. to secure payment of $175,000 bonds.

Water Supply.—Richland creek and branch of same, filtered, pumping from impounding reservoir to reservoir and stand-pipe.

Dams and Impounding Reservoirs.—Cap., est., 230,000,000 galls. *No.* 1, cap., 30,000,000 galls.; area, about 12 acres; on Richland creek, about one mile from town; partly in excavation. Dam of earth, dimensions not given. Inner slope covered with concrete. *Spillway:* near center of dam, 90 ft. long, 6 ft. high, stone. Built in '85. Engr., see History. *No.* 2, *or Lake Christine:* cap., est., 200,000,000 galls.; area, 30 acres; depth at dam, 20 ft., over considerable part, 20 to 10 ft.; a mile above No. 1, on branch of creek. Dam of earth, mostly clay, unpuddled, with heart-wall; 430 ft. long, 25 ft. high, about 12 ft. wide on top, 100 ft. at bottom. Inner slope, 2 to 1; outer, 1½ to 1. *Heart-wall:* 2-in. plank, doweled together with iron pins, ex-

tending below bottom of discharge-pipe and to water-line at 5 ft. from top; clay tamped in on each side of plank. *Spillway:* at extreme end of dam, 16 ft. wide, 4 ft. high, of oak timber. *Discharge-pipe:* 12-in., with provision for drawing water from bottom controlled by valve and with upright branch, open at top, extending from foot of inner slope to within 6 ins. of water line; timber crib incloses upright pipe and valves. Built in '88. Engr., M. T. Stookey, Gen. Mgr. Consult. Engr, S. H. Lockett, N. Y. City.

Filter Basin.—Formed by building dam across cove of old reservoir and covering reservoir side of bank with 4½ ft. of sand and gravel, other side being paved with brick. Drains lead through bank.

Pumping Machinery.—Dy. cap., 2,500,000 galls.; two Worthington, comp., dup. *Boilers:* two 70-H. P., Whittier.

Filter. Dy. cap., 325,000 galls.; Hyatt; erected July, '87.

Distributing Reservoir.—Cap., 3 000,000 galls., depth, 20 ft.

Stand-Pipe.—Cap., 130,000 galls.; 12x120 ft.; on hill 117 ft. above city.

Distribution.—*Mains*, c. i., 14 miles. *Services*, lead. *Taps*, 315. *Meters*, 15. *Hydrants*, Ludlow, 105. *Valves*, Ludlow.

Consumption, 600,000 galls. *Pressure:* Ordinary, 65 lbs. Fire, 130 lbs.

Financial.—Cost (in '87), $175,000. Cap. stock (in '88), $250,000. Debt, $175 000. Int., 6%. Ann. op. exp., $6,000. Ann. rev.: consumers, $9,000; city, $6,565. Hydrant rental, $65.

Management.—Prest., R. N. Hazard. Secy., J. M. McGuire. Treas. and Gen. Mgr., M. T. Stooky.

BLOOMINGTON, *McLean Co.* (Pop., 17,180; est., 28,000.) On undulating prairie. Has extensive manufactories. Settled in '31; incorp. city in '50. Has sewers and electric lights.

History.—Built in '75 by city. Des. Engr., H. P. M. Birkinbine. Const. Engr., Ira Merchant. Engr. for extensions, Geo. C. Morgan, Chicago

Water Supply.—Surface and 8 tube wells, pumping to stand-pipe and direct. Surface well is 40 ft. diam. for 28½ ft., then has an 18-in. pipe sunk 10 ft. deeper. Ground at this point is 68 ft. below highest point in the city.

Pumping Machinery.—Dy. cap., 3,000,000 galls.: 1,000,000 Worthington, erected in '75, and 2,000,000 Blake, added in '81.

Stand-Pipe.—Cap., 75,000 galls.; 8 x 20 ft.; on ground 35 ft. above engine house floor. Foundation octagonal, stone, heavy casting placed on this, forming the base of pipe. Octagonal brick tower encloses pipe, being built 2 ft. from it. There is winding staircase in space between. Base of wall is 6 ft., and top 1 ft. thick. It has stood well.

Distribution.—*Mains*, c. i., 18 miles. *Services*, w. i., lead. *Taps*, 1,136. *Meters*, 210. *Hydrants*, Mathews, Flower, 205. *Valves*, Eddy.

Consumption, 700,000 galls. *Pressure:* Ordinary, 85 lbs. Fire, 150 lbs.

Financial.—Cost (in '87), $135,000. Bonded debt, $75,000. Int., 8%. Ann. op. exp. $11,000. Ann. rev.: consumers, $14,791. Op. exp. for '80 were $5,427. and rev., $7,614.

Management.—Water Board of three. Supt., H. W. Schmidt.

BLUE ISLAND, *Cook Co.* (Pop., 1,542; est., 3,000.) Is 16 miles from Chicago. Has brick yards, stone quarries and smelting works. No sewers. Has electric lights.

History.—Built in '76 by village.

Water Supply.—Well, pumping to tank.

Pumping Machinery.—Dy. cap., 1,350,000 galls.; Buffalo, erected in '86.

Tank.—Cap., 60,000 galls.; on 50-ft. stone tower.

Distribution.—*Mains*, c. i., 4 miles. *Services*, w. i. *Taps*, 175. *Meters*, 4. *Hydrants*, 50.

Consumption, 50,000 galls. *Pressure*, not given.

Financial.—Cost, $30,000. Bonded debt, $13,000. Int., 6%. Ann op. exp., est., $3,000, including operation of electric light plant. Ann. rev.: consumers, $1,600.

Management.—Clerk, F. Hohman. Supt., A. Reiner.

BLUE MOUND, *Macon Co.* (Pop. of township, 1,204: est., of village, 800.)

History.—Built for fire protection in '86 by village. Engrs. and Contrs., Fairbanks, Morse & Co., Chicago. **Water Supply.**—Well, pumping to tank and direct. **Pumping Machinery.**—Not given. **Tank.**—Cap., about 25,000 galls. **Distribution.**—(In '87.) *Mains*, Wyckoff wood, 2,000 ft. *Services*, iron. *Hydrants*, 8. **Financial.**—(In '87.) Cost, $3,500. Bonded debt, $2,000. Int., 6%. **Management.**—Report by G. W. Drysdale.

BUCKLEY, *Iroquois Co.* (Pop., est., 500.) Incorp. village. No sewers or electric lights.

General Description.—Built in '89-90 by village, for fire protection. Supply, well, pumping to tank. Windmill pump from Challenge Windmill Co., Batavia. *Mains*, ½ mile. *Hydrants*, 5. Cost, $2,000. Debt, $500. Village Clerk, J. M. Linkenmeyer. Latest report, Jan. 9, '90.

BUDA, *Bureau Co.* (Pop., 778; est., 1,000.)

History.—Built in 83 by Buda Water-Works Co.

Water Supply.—Source not given, pumping to tank.

Pumping Machinery.—Force pump, driven by windmill.

Tank.—Cap., about 30,000 galls.; 40 ft. high.

Distribution.—(In '87.) *Mains*, Wyckoff wood, 500 ft. *Taps*, 10. *Hydrants*, Holly, 4.

Financial.—(In '87.) Cost, $2,000. Cap. stock, $2,000.

Management.—Prest., T. J. Lockwood.

NOTE.—Works are reported as being in dilapidated condition.

BUSHNELL, *McDonough Co.* (Pop., 2,316; est., 2,400.) Has manufactories.

NOTE.—About July 20, '89, a resident stated that city had let contract for works to cost $25,000. System said to include pumps, stand-pipe, 2 miles 8 to 4-in. mains, 12 hydrants; cost, $15,000. Address O. C. Hicks or J. Cole.

CABERY, *Ford Co.* (Pop., est., 600.) Has brick and tile works. Incorp. No sewers or electric lights.

History.—Built in '87 by village. Engr. and Contr , Jas. Porch, Chebanse, Ill.

Water Supply.—Artesian well, pumping to tank.

Pumping Machinery.—Dy. cap , 15,000 galls.; "Sandwich."

Tank.—Cap., 45,000 galls.

Distribution.—*Mains*, 8 to 4-in. iron, 4,000 ft. *Services*, iron. *Taps*, 23. *Meters*, none. *Hydrants*, Beaumont, 14. *Valves*, Beaumont.

Consumption, 1,000 galls. *Pressure*, not given.

Financial.—Cost, $6,800. Debt, $2,000. Int., 6%. Ann. op. exp., $35. Ann. rev. consumers, $115.

Management.—Village Prest., P. Whalen.

CAIRO, *Alexander Co.* (Pop., 9,611; est., 15,000.) At junction of Ohio and Mississippi rivers. Engaged in manufacturing and trade. Has sewers and electric lights.

History.—Built in '85 and put in operation Jan 1, '86, by Cairo Water Co.; originally controlled by Peter Herdic, deceased. Const. Engr., —— Ditmar, Williamsport, Pa. Labor done by Co.

Water Supply.—Ohio river, pumping to stand-pipe or direct. Unofficially reported that filtering crib was built in '88.

Pumping Machinery.—Dy. cap., 4,000,000 galls.; two Gordon & Maxwell, comp., dup.; one 16-in. high-pressure, other, 28-in. low-pressure, each of 24-in. stroke.

Stand-Pipe.—Cap., 225,600 galls.; 16 x 150 ft. Contrs., Maittang & Son, Peoria.

Distribution.—*Mains*, c. i., about 15 miles. *Services*, galv. i. *Taps*, 345. *Meters*, none. *Hydrants*, kind not given, 158. *Pressure-recording gauge*, Edson.

Consumption, 1,500,000 galls. *Pressure*, 65 lbs.

Financial.— Cost (in '87), $130,000. Cap. stock, $100,000. Bonded debt, $100,000. Int., 6%. Ann. op. exp., withheld, est., $3,000. Ann. rev.: consumers, $1,800; city, $6,500.

Management.—Prest., H. B. Mellick. Secy., H. Hinckley. Supt., W. Porteus.

CANTON, *Fulton Co* (Pop., 3,762; est., 5,000.) Is 28 miles from Peoria. Manufactures ploughs, wheels and cigars and mines coal. Incorp. in '49. Partially sewered. Has electric lights.

History.—Built in '84 by town. Engr. and Contr , Geo. C. Morgan, Chicago.

Water Supply.—Surface wells, pumping to stand-pipe and direct if required. Water is also used from artesian well, 2,500 ft. deep; this water is slightly salt, and has much magnesia and soda in it, though constant pumping improves it. Filter projected.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Worthington comp., dup.

Stand-Pipe.—Cap., 25,380 galls.; 12 x 30 ft.; on brick tower 70 ft. high.

Distribution.—*Mains*, 8-in. c. i., 1⅞ miles. *Services*, w. i. *Taps*, 125. *Meters*, 6. *Hydrants*, kind not given, 30.

Consumption, 100,000 galls. *Pressure:* Ordinary, 33 lbs. Fire, 200 lbs.

Financial.—Cost, $28,000. Debt, $25,000. Int., 5%. Sinking fund, $2,400. Ann. op. exp., $1,000. Ann. rev.: consumers, $1,100; city, $3,000. Hydrant rental, about $100.

Management.—Supt., I. T. Atwater.

CARLINVILLE, *Macoupin Co.* (Pop., 3,117; est., 4,500.) Incorp. city. No sewers. Has electric lights.

History.—Built in '89-90 by Carlinville Water Co., under 30-years franchise to F. Wm. Raeder; put in operation in Jan. City has right to purchase works at expiration of 15 years from date of franchise (Dec. 7, '88) and at end of each succeeding 5 years. If not purchased at end of 30 years franchise becomes renewed. Engr., F. Wm. Raeder, St. Louis, Mo.

Water Supply.—Macoupin creek, filtered, pumping to stand-pipe or direct. Drainage area, 125 sq. m., mostly woodland,

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Deane comp., dup. *Boilers:* from Armstrong Bros., Springfield, O.

Filter.—Dy. cap., not given; American.

Stand-Pipe.—Cap., 70,000 galls.; 12 x 120 ft.; from Jno. O'Brien Boiler Works, St. Louis, Mo.

Distribution.—*Mains*, 10 to 4-in. w. i. and cem., 5 miles; from Illinois Pipe Mfg. Co.; laid by Loomis & Garris. *Services*, w. i., dipped in asphaltum. *Taps*, 40. *Meters*, none. *Hydrants*, Beaumont, 52. *Valves*, Ludlow.

Pressure: Ordinary, 50 lbs. Fire, at pumps, 150 lbs.

Financial.—Cost, $60,000. Cap. stock, authorized, $75,000; all paid up. Bonded debt, $50,000. Bonds authorized, $75,000. Int., 6%. Hydrant rental, $3,000 for first 52, or about $60 each; additional, $50.

Management.—Prest., W. G. Reeve, Peru, Ill. Secy., F. Wm. Raeder, St. Louis, Mo. Supt., Geo. Sigel. Latest report, Mar. 7, '90.

CARLYLE, *Clinton Co.* (Pop., 2,017; est., 2,500.) On Kaskaskia river. Incorp. Has sewers and electric lights.

History.—Built in '87 by Carlyle Water, Light & Power Co., under 21-years franchise. Engr., F. W. Raeder, St. Louis, Mo. Contrs., for all but masonry and buildings, Water, Light & Power Co., St. Louis, Mo.

Water Supply.—Kaskaskia river, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Deane, dup. *Boilers:* from Jas. Wrangler, St. Louis, Mo.

Stand-Pipe.—Cap., 70,000 galls.; 10 x 110 ft.; steel. Contrs., Shickle, Harrison & Howard Iron Co., St. Louis, Mo.

Distribution.—*Mains*, c. i., 3½ miles. *Services*, galv. i. Pipe and specials from Shickle, Harrison & Howard Iron Co., St. Louis, Mo.; trenching and pipe-laying done by F. W. Nephon, St. Louis, Mo. *Taps*, 48. *Meters*, none. *Hydrants*, Ludlow, 50. *Valves*, Ludlow.

Consumption, 30,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 125 lbs.

Financial.—Cost, $35,000. Cap. stock, $20,000; intention was to increase it in '89. Bonded debt, $35,000. Ann. op. exp., $1,200. Ann. rev.: consumers, $900, of which $600 is from O. & M. R. R. Co.; city, $2,100. Hydrant rental, $48.83, 15-years contract.

Management.—Prest., J. J. Randall. Secy., F. W. Raeder, St. Louis, Mo. Supt., J. Taylor. Address the Prest.

CARTHAGE, *Hancock Co.* (Pop., 1,594; est., 2,500.)

History.—Built in '87 by town, under direction of committee. Const. Engr. and Contrs., U. S. Wind Engine & Pump Co., who partly own works.

Water Supply.—Artesian well, 1,800 ft. deep, pumping from receiving reservoir to tank and direct.

Tank.—Cap., 61,770 galls.; 20 x 24 ft.; on elevation 60 ft. above ground.

Receiving Reservoir.—Cap., 60,000 galls.

Pumping Machinery.—Dy. cap., 500,000 galls; Knowles, dup.

Distribution.—(In '87.) *Mains*, 6, 5 and 4-in. Wyckoff wood, 1 mile. *Services*, not given. *Taps*, 25.

Pressure: Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—(In '87.) Cost, $14,000. Debt, $10,000. Int., 6%. Ann. op. exp., withheld, est. (in '88), $800. Ann. rev.: consumers, withheld, est. (in '88), $500.

Management.—(In '88.) Com.: T. J. Schofield, Jno. Elder and E. M. Robbins.

CHAMPAIGN and URBANA, *Champaign Co.* (Pop.: Champaign, 5,103; est., 6,500. Urbana, 2,942; est., 3,000.) Towns are adjacent, on level ground, 720 ft. above sea. Incorp. No sewers. Have electric lights in connection with water-works.

History.—Built in '85 by Union Water Supply Co., under 30-years franchise from Champaign and 15-years franchise from Urbana. Engr., Chas. H. Ledlie. Consult. Engr., T. J. Whitman. Both of St. Louis, Mo.

Water Supply.—Surface well, filtered, by direct pumping and pumping to reservoir. Well is an abandoned prospecting coal shaft, 8 x 12 ft., x 80 ft deep. Before pumping, water was 40 ft. below surface.

Pumping Machinery.—Dy. cap., according to makers, 2,000,000 galls.; as per Co.'s report, 750,000 galls.; two Gordon & Maxwell, vertical, comp. *Boilers:* from Robinson & Burr.

Filter.—Dy. cap., not given; National.

Reservoir.—Cap., 250,000 galls.; 60 ft. sq. x 16 ft. deep; in excavation and embankment, lined with brick in cem.

Distribution.—*Mains*, c. i., 14 miles: 8 in Champaign and 6 in Urbana. *Services*, kind not given. *Taps*, 300. *Meters*, 8. *Hydrants*, Ludlow, 100. *Valves*, Ludlow.

Consumption, 250,000 galls. *Pressure:* Ordinary, 30 lbs. Fire, 90 lbs.

Financial.—Cost, $225,000. Cap. stock, $100,000. Bonded debt, $100,000, Int., 6%. Ann. op. exp., $5,000. Ann. rev.: (including rev. from electric lights) consumers, $5,000; cities, $7,000. Hydrant rental, $75 in Champaign $40 in Urbana.

Management.—Prest., L. H. Trerett. Secy. and Treas., Wayne Lundit. Supt., S. L. Nelson.

CHARLESTON, *Coles Co.* (Pop., 2,867; est., 4,000.) On undulating prairie, 3 miles west of Embarras river. Manufactures flour, brooms and woolen goods. Settled in '33; incorp. city in '73. No sewers. Has electric lights.

History.—Built in '76 by city.

Water Supply.—Embarras river, direct pumping. River is 134 ft. below city, and 3 miles distant.

Pumping Machinery.—Dy. cap., 1,200,000 galls.; Dean double crank, erected in '76.

Distribution.—(In '87.) *Mains*, c. i., 10 miles. *Services*, galv. i. Pipe and specials from Dennis Long & Co., Louisville, Ky. *Taps* (in '86), 600. *Meters*, none. *Hydrants*, kind not given, 35.

Consumption, not given. *Pressure:* Ordinary, 75 lbs. Fire, 100 lbs.

Financial.—(In '87.) Cost, $40,000. Bonded debt, $21,000. Int., 10%. Ann. op. exp., $3,300. Ann. rev.: consumers, $3,500.

Management.—Secy. Water-Board, J. Trainer. Supt., Frank Cooper.

CHEBANSE, *Iroquois Co.* (Pop., 728; est., 900.)

History.—Built in '76 by Chebanse Water-Works Co., under direction of Jas. Porch and R. Nation.

Water Supply.—Source not given, pumping to tank.

Pumping Machinery.—Force pump, driven by windmill.

Tank.—Cap., about 30,000 galls.

Distribution.—*Mains*, 4 and 6-in. c. i., 1,500 ft. *Services*, not given. *Taps*, 20. *Meters*, none. *Hydrants*, Beaumont, 16.

Consumption and *Pressure*, not given.

Financial.—Cost, $3,500. Cap. stock, $3,500. No debt. Ann. op. exp., $50. Ann. rev.: consumers, withheld, est., $500; city, none.

Management.—Geo. Burrill. Secy., Jas. Porch. Supt., F. Russell.

CHICAGO, *Cook Co.* (Pop., 503,185; est., 875,000.) On Lake Michigan, 591 ft. above sea, on plain, which was originally low and swampy, with an av. elevation of 12 ft. above lake. City lies on both sides Chicago river, for 5 miles from mouth of which, in any direction, city is not more than 23 ft. above lake. In '89 a large adjoining territory was annexed, including Hyde Park, Lake and Lake View. Has sewers and electric lights.

History.—First supplied in '40 by Chicago Hydraulic Co.; since '54 by works built by city in '52-4.

First works consisted of an 18-in. intake, extending from a crib in Lake Michigan 700 ft. to a pump-well, 15 ft. deep, from which a steam pump forced water through several miles of 2, 3 and 6-in. wooden pipe. Pop. in '40 was 4,500.

In '51 Legislature incorp. Chicago City Hydraulic Co., composed of 3 Comrs., elected by people. When these works were finished, in '54, pop. was about 75,000. Des. Engr., Wm. J. McAlpine.

In '61 works came under control of Board of Public Works, with E. S. Chesbrough as City Engr. Mar. 17, '64, construction of first lake tunnel was begun, and it was finished Mar. 25, '67. Second lake tunnel was built in '72-4, and a third is now in progress.

In great fire of '71 pumping station was burned, engines being damaged so that one was not put in use again for 8 days, and others for nearly a month. First week after fire a partial supply was obtained by pumping from wells to the mains.

In '87 work was begun on a new tunnel, and in '88 on two large new pumping stations. These improvements, with new pumps, will greatly increase the cap. of the works. The new works will probably be in full operation early in '91, but it is expected that the new pumps will be connected with the old tunnel before then.

By annexation of Hyde Park, Lake and Lake View, in '89, city came into possession of works formerly supplying these towns, and now operates them as divisions of city works. These divisions are described separately below, after the main works.

For description of the main works prior to May 6, '61, see MANUAL for '88, p. 370.

MAIN WORKS.

Water Supply.—Lake Michigan, by direct pumping, water being taken from lake through tunnels.

First Tunnel.—Extends from shaft near shore to crib inclosing a shaft two miles out in lake; 5 ft. wide, 5 ft. 2 ins. high, lined with brick, driven through clay, about 30 ft. below lake bottom. Cost, $457,845.

First Pump-Well.—Receives water from tunnel at North Side Station; 21 ft. deep, in quicksand. A brick masonry curb was built, 31½ ft. inside diam., and 2¾ ft. thick at bottom, resting on iron shoe 2½ ft. deep, with cutting edge. Excavation was made with a dredging machine.

Bottom of well was covered with two courses of 3-in. oak plank, on which 10-in. pine timbers were placed, filled between with concrete, and covered with another course of 3-in. oak plank, then 9 ins. of concrete. On this were built foundations of the first two pumping engines. Other pump-wells have been sunk since this.

Second Tunnel.—Is 7 ft. in diam., parallel to and 46 ft. from first. Shaft was sunk in lake near crib of first tunnel, and a cross tunnel run between the two. At shore end this tunnel is connected with North Side station, then continued through city 4 miles, passing under Chicago river and South Branch, to West Side station, delivering into a pump-well 10 x 44 ft., with walls of squared stone founded on rock 44½ ft. below surface.

Third Tunnel and Intake.—Under construction. Total length, about 5½ miles. From shore shaft at Park Row tunnel extends 4 miles easterly into lake, to intake crib, and about 1½ miles beneath city to connect with New Central st. and Fourteenth st. pumping stations, and also with old tunnel. Diam., in various parts, 6, 7 and 8 ft.; lake section has two branches 6 ft. in diam., equal to 8-ft. tunnel. On land section 6 shafts were sunk, one of which was abandoned: on lake section 3 shafts were sunk, ½, 2½ and about 4 miles from shore shaft, latter being at intake crib. These shafts are protected by caissons, first two from shore being of 12 x 12-in. timbers, made fast by 1½-in. drift bolts. The second shaft and caisson are temporary; from first temporary supply may be drawn pending completion of tunnel. Third caisson, or intake crib, is circular, 125 ft. external diam. at base, 118 at city datum, or water surface, 70 ft. internal diam., 53 ft. high; sunk in 42 ft. of water. From timber grillage at bottom, 13 ft. high, two cylinders of ⅜-in. steel plates rise to 3 ft. above water surface to form outer and inner shell of caisson; space between filled with concrete, and inner and outer granite walls carried up 8 ft. higher, with space between filled with more concrete. Six port-holes, 5 ft. sq., with gates and fish screens, are carried through timber grillage; and 24 radial bulkheads connect the two cylinders. Inlet shaft is 10 ft. in diam., of 2½-in. c. i., with two 5 x 6-ft. gates near top.

Work on land section begun Dec. 20, '87: first 3 shafts and 480 ft. of 6-ft. tunnel done by city, under direction of Wm. Innes. Work on lake section begun in June, '88. Contr. for this and balance of land section, Andrew Onderdonk. Dec. 31, '88, all the land shafts had been connected, excepting 324 ft. between Clark St. and Fourth Ave., which was finished in '89. Excluding the above 324 ft., this work comprised 6 shafts (one abandoned), with total depth of 402 ft.; 264 ft. of 8-, 6,740 of 7-,

876 ft. of 6-ft. Total length land section, 8,204 ft. Less than 1 mile of lake section completed in '89; difficulties were encountered, so that in place of proposed 8-ft. tunnel; 2 6-ft., 50 ft. apart have been started. It was hoped that these could be joined in one 8-ft. tunnel about 1 mile from shore.

Pumping Machinery.—Dy. cap., 153,000,000 galls. Contracts for additional pumps with a cap. of 75,000,000 galls. were let in '88 to E. P. Allis & Co., Milwaukee, Wis. At North Side station there are 4 double and 2 single pumps, 2 of these being Holly-Gaskill pumps, with a dy. cap. of 12,000,000 galls. each, erected in '87.

At West Side station there are 4 pumps. Aside from Holly pumps, others were built by Morgan Iron Works and Quintard Iron Works, N. Y. City; Knapp Foundry and Pitt Foundry Co., Pittsburgh, Pa.

At West Side station in '88 total pumpage was 21,046,189,980 galls., against a head of 100½ ft. Total cost of raising 1,000,000 galls. was $4.656, or raised 1 ft., 4.632 cents.

At North Side station in '88 total pumpage was reported as 15,553,034,775 galls., against 100-ft. head. Total cost of raising 1,000,000 galls. was reported as $7.977, or raised 1 ft., 7.977 cents.

Stand-Pipes.—One at North Side station, 3 ft. in diam., 133 ft. high, inclosed in octagonal stone tower 154 ft. high. About '76 one was built at West Side station, 5 ft. in diam., 167 ft. high; inclosed in ornamental masonry tower 190 ft. high. Old stand-pipe, noted on p. 370 of MANUAL for '88, was at one time 14 ins. out of plumb. not 14 ft.

River Crossings.—Frequent accidents to submerged mains led to construction of brick tunnels, 6 ft. in diam., in which the pipes are laid.

Distribution.—*Mains*, c. i., 677.76 miles. *Services*, lead. *Taps*, 125,667. *Meters*, 3,122. *Hydrants*, mostly Cregier, 5,099. *Pressure-recording gauge*, Edson.

Consumption, "about" 100,136,506 galls. *Pressure*, 25 lbs.

Close of '77: Mains, 424.6. Taps, 59,369. Meters, 1,623. Hydrants, 3,002. Consumption, 52,000 galls. (Consumption in '67, 11,600,000 galls.)

Financial.—Cost, $12,390,464. Debt (subject to correction, but as nearly as can be ascertained), $3,955,000: $3,340,000 at 7, $132,000 at 6, $150,000 at 4, $333,000 at 3.65%. Ann. op. exp., about $400,000. Ann. rev.: total, $1,557,117.

Cost to May 6, '61, when works were transferred from Board of Water Comrs. to Board of Public Works, $1,020,060. Cost, close of '77, $8,344,350; do., Jan. 1, '80, $8,644,754. Rev., '60, $131,163; do., '70, $539,180; do., '80, $865,618, or $41.21 per million galls. pumped. Total op. exp. and maintenance to Dec. 31, '88, $7,710,751; int. on bonds, do., $6,454,695; bonds cancelled, $859,000. Total rev.to Dec. 31, '88, $21,384,509. Surplus rev. above op. exp., maintenance and int., $7,219,063.

For Management see below.

HYDE PARK AND LAKE DIVISION.

History.—In '74 Hyde Park and Lake built works together, as described in MANUAL for '88, p. 389, under Town of Lake. In '82 Hyde Park gave up its interest in the plant, and built independent works for supply, as described below. With annexation of these towns to Chicago, in '89, the intake and pumping station of Lake works were abandoned, and return made to original plan.

Water Supply.—Lake Michigan, through tunnel, direct pumping.

Temporary Intake.—C. i., 16-in.; laid on lake bottom for 1,620 ft., and a tunnel from this to engine-house, 1,000 ft. long, and 5 ft. 2 ins., in diam.

Lake Tunnel.—Is 6 ft. in diam. and 1¼ miles long. (See References, below.)

Pumping Machinery.—*Hyde Park:* dy. cap., 30,000,000 galls.; 12,000,000 Gaskill, 6,000,000 Cope & Maxwell, or Gordon, 12,000,000 Worthington; latter added in '89. A 2,000,000 Holly formerly in use.

Lake: Dy. cap., 23,000,000 galls.; two 4,000,000 Gaskill vertical, 12,000,000 Gaskill, 3,000,000 Knowles.

Distribution.—[Owing to change, figures for '88 could not be obtained, therefore subjoined are given for each place separately, being for '87 unless otherwise specified.]

Hyde Park: Mains, c. i., 95 miles. *Services*, lead. *Taps*, not given. *Meters*, Worthington, 75. *Hydrants* (in '83), 435.

Consumption, about 9,000,000 galls. *Pressure*, 65 lbs.

Lake: Mains, c. i., 140 miles. *Services*, lead. Taps, 10,000. *Meters*, Worthington (in '84), 81. *Hydrants*, Holly (in '84), 400. *Valves*, Eddy, Ludlow. *Pressure-recording gauge*, Edson.

Consumption (in '88), 15,000,000 galls. *Pressure*, 70 lbs.

Financial.—[See note under Distribution.]

Hyde Park: Cost (in '83), $750,000. Debt (in '83), $451,000. Int., not given. Ann. exp., $34,000. Ann. rev.: consumers, $95,000.

Lake: Cost, about $1,000,000. Debt, $425,000. Int., 6%. Ann. op. exp., $70,000. Ann. rev.: consumers, not given, est., $150,000.

LAKE VIEW DIVISION.

History.—Built in '75-6 by Lake View. Engrs., Jno. A. Cole and J. W. Alvord, Ashland Block, Chicago. In '89 these works came into possession of Chicago, by annexation.

Water Supply.—Lake Michigan, by direct pumping and pumping to tanks.

Intake-Pipes.—W. i., one 16-in., and extending 1,700 ft. into the lake, one 20-in., extending 2,000 f. In addition there is a shore inlet for use in case of emergency from fire or anchor ice. The submerged pipes have flexible joints, and terminate at the shore end in the pump-well, and at lake end in w. i. crib, 16 ft. sq. The dy. cap. of the submerged pipe is 8,000,000 galls.

Proposed Tunnel.—Prior to '89 plans were prepared by Saml. G. Artingsall, Chicago, for brick tunnel 9 ft. in diam., extending into Lake Michigan 6,000 ft. to 25 ft. of water. Concrete and masonry inlet crib was to be built, 75 ft. in diam. and extending 15 ft. above water level, with interior well 30 ft. in diam., having four 4-ft. apertures at bottom connected with lake.

Pumping Machinery.—Dy. cap., 19,500,000 galls.; new 12,000,000 Gaskill, Worthington, Flanders.

Tanks.—Two, 12 and 15 ft. in diam., respectively, with bottoms 16 ft. below av. lake level.

Distribution.—(In '87.) *Mains*, c. i., 80 miles. *Services*, lead. *Taps*, 600. *Meters*, Worthington, number not given. *Hydrants*, "Wood's [Mathews] preferred," number not given.

Consumption (in '87), 6,000,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 70 lbs.

Financial.—(In '87.) Cost, $500,000. Bonded debt, $150,000. Int., 4 to 7%. Ann. op. exp., $50,000. Ann. rev.: consumers, $60,000.

Management.—[Main and divisional works.] Comr. Public Works, W. H. Purdy. City Engr., Wm. R. Northway. Supt. Rates, E. Hamilton. Supt. Meters, Godfrey Baker. Chf. Engr., Hyde Park, Lake and Lake View Works, Robt. Hawkins, Park Side. Chf. Engr., North Pumping station, Henry Welch. Do. West, Jas. Stewart.

REFERENCES.—"Hyde Park Tunnel and Inlet Crib." By C. McLennan, C. E., with plan of tunnel and detail of inlet crib. *Eng. News*, Vol. XXI., pp. 26-8.

CLINTON, *De Witt Co.* (Pop., 2,709; est., 4,000.) Has railway machine shops. Incorp. city. Sewers contemplated. Has electric lights.

History.—Built in '87-8 by city. Engr., Jno. W. Nier, Kansas City, Mo.

Water Supply.—Well, direct pumping. Contr. for well, R. H. Ross, Clinton.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; Deane.

Distribution.—*Mains*, kind not given, 5⅞ miles. Pipe and specials from Ripley & Bronson, St. Louis, Mo. *Taps*, 108. *Meters*, 5. *Hydrants*, Bourbon, 45. *Valves*, Bourbon.

Consumption, 90,000 galls. *Pressure*, 50 lbs.

Financial.—Cost, $37,000. Bonded debt, $17,000. Int., 5%. Ann. op. exp., $1,800. Ann. rev.: consumers, $800.

Management.—Council. Clerk, J. W. Brown. Supt., J. E. Moffett.

DANVILLE, *Vermillion Co.* (Pop., 7,733; est., 1,200.) On Vermillion river in bituminous coal region. Settled about '10; since incorp. city. No sewers. Has electric lights

History.—Built in '82-3 by Danville Water Co., under 30-years franchise. Des. Engrs., K. P. Corbyn and Frank Shefold. Const. Engr., J. M. Carson, present Supt. Contr. for masonry, P. M. Norton; for buildings, J. M. Hunkey. Both of Danville.

Water Supply.—North Fork of Vermillion river, and Clear lake reservoir, pumping to stand-pipe.

Intake Pipe.—Diam., 20 ins.; passes from stream through revetment wall and delivers water to settling well, with provision for direct connection with pump-well.

Settling Well.—Cap., 180,000 galls.; 40½ ft. diam., 27 ft. deep. A 20-in. pipe extends to pump-well; latter is 18 ft. in diam.

Clear Lake Reservoir.—Not described.

Pumping Machinery.—Dy. cap., 4,000,000 galls.; two Blake. *Boilers:* four, 5 x 18 ft.

Stand-Pipe.—Cap., 10,000 galls.; 3½ x 200 ft., of ½-in. iron; founded on masonry 12 ft. sq. and 12 ft. thick with brick casing for 100 ft., above which it is double riveted. Contrs., Rohan Bros., St. Louis, Mo.

Distribution.—*Mains*, c. i., 14 miles. *Services*, galv. i. Pipe and specials from Dennis Long & Co., Louisville, Ky.; trenching and pipe-laying done by L. M. Brown & Co., Danville. *Taps*, 564. *Meters*, 29. *Hydrants*, Ludlow, 107. *Valves*, Ludlow. *Pressure-recording gauge*, Edson.

Consumption, 300,000 galls. *Pressure:* Ordinary, 70 lbs. Fire, 85 lbs.

Financial.—Cost, $250,000. Cap. stock, $200,000. Bonded debt, $150,000. Int., 7%. Ann. op. exp. (in '87), $3,782, including all taxes. Ann. rev. (in '87): consumers, $10,500; city, $7,937. Hydrant rental, $75 for first 100, $62.50 for next 45, and $50 for additional.

Management.—Prest., S. A. Miller. Secy., Wm. Reinecke. Both of Louisville, Ky. Supt. and Engr., L. W. Straw.

DECATUR, *Macon Co.* (Pop., 9,547 est., 16,000.) On right bank of Sangamon river on flat bottom land, soil being underlaid with gravel. Incorp. Has sewers and electric lights.

History.—Built in '71 by town. Const. Engrs., Kinsey & Mahler.

Water Supply.—Sangamon river, by direct pumping.

Filter Crib.—Is 600 ft. long, 10 ft. wide, 6 ft. high, arched over. Water conveyed from this to pump-well. At first a 22-in pipe connected pump-well and river; independent connection is still maintained for use in dry weather.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; Allis. Two Cameron and 1,000,000 Holly rotary were first used.

Distribution.—*Mains*, c. i., 14¼ miles. *Services*, w. i., lead. *Taps*, 810. *Meters*, 11. *Hydrants*, Holly, Mathews, Galvin, 149.

Consumption, 200,000 galls. *Pressure:* Ordinary, 45 lbs. Fire, 80 lbs.

Financial.—Cost, $160,000. Debt, $35,500. Int., not given. Ann. op. exp., $10,000. Ann. rev.: consumers, $16,500.

Management.—City Clerk, F. C. Betzer. Chf. Pumpg. Engr. (in '88), Jno. T. Barnett.

DE KALB, *De Kalb Co.* (Pop., 1,598; est., 3,000.) On Kishwaukee creek, on level ground. Manufactures barbed fence wire. Settled in '36; incorp. village in '51.

History.—Built in '74 by village. Engr. and Contr., Geo. C. Morgan, Chicago.

Water Supply.—Artesian well, 6 ins. diam. x 2,500 ft. deep, pumping to tank.

Pumping Machinery.—Dy. cap., about 100,000 galls.; Deane dup. Windmill formerly used for power.

Tank.—Cap., 60,000 galls.; 25x16 ft.; 48 ft. above pump, 65 ft. above main street.

Distribution.—(In '87.) *Mains*, c. i., 3 miles. *Services*, lead. *Taps*, 200. *Meters*, none. *Hydrants*, Ludlow, 35.

Consumption (in '87), 60,000 galls. *Pressure:* Ordinary, 20 lbs. Fire, 110 lbs.

Financial.—(In '87.) Cost, $3,000. No debt. Ann. op. exp., $355. Ann. rev.: consumers, $1,600.

Management.—(In '88.) Supt., L. R. Waldron.

NOTE.—No report for '89 can be obtained.

DIXON, *Lee Co.* (Pop., 3,658; est., 5,000.) On Rock river, which furnishes water-power. Has electric lights.

History.—Built in '84 by A. H. McNeal and S. S. Murphy, Burlington, N. J., and sold to Dixon Water Co., Mr. Murphy holding nearly all stock.

Water Supply.—Rock river and springs, pumping to reservoir and direct.

Pumping Machinery.—Dy. cap., 2,500,000 galls.; Gordon.

Reservoir.—No data.

Distribution.—*Mains*, kind not given, 7 miles. *Services*, not given. *Taps*, about 200. *Meters*, 5. *Hydrants*, kind not given, 65.

Consumption, 200,000 galls. *Pressure:* Ordinary, 45 lbs. Fire 100 to 150 lbs.

Financial.—Cost, about $80,000. Cap. stock, $80,000. Bonded debt, $80,000. Int., 6%. Ann. op. exp., about $2,000. Ann. rev.: consumers, withheld, est., $5,000; city, $1,875. Hydrant rental, $75.

Management.—Prest., Jno. D. Crabtree. Treas., Jas. A. Hawley. Supt., Jno. Wasley.

EAST DUBUQUE, *Jo Daviess Co.* (Pop., 1,037; est., 1,400.) On Mississippi river, opposite Dubuque, Ia. Bluffs on east and north side of town. Incorp. No sewers or electric lights.

History.—Built in '83 by city.

Water Supply.—Artesian well, pumping to reservoir.

Pumping Machinery.—Dy. cap., 250,000 galls.; Smedley.

Reservoir.—Cap., 100,000 galls.; 12x100 ft., x 12 ft. deep.; on bluff.

Distribution.—*Mains*, 6 and 4-in., 1½ miles. *Taps*, 20. *Meters*, none. *Hydrants*, Ludlow, 10.

Pressure, 30 to 70 lbs.

Financial.—Cost, $8,000. Debt, not given. Ann. op. exp., withheld, est., $500. Ann. rev.: consumers, "free to all."

Management.—Pumpg. Engr., T. Dames. Report, July 31, '89.

EAST SAINT LOUIS, *St. Clair Co.* (Pop., 9,185; est., 22,000.) On Mississippi river, opposite St Louis, Mo. Has electric lights.

History.—Built in '86, under 20-years franchise, by City Water Co., controlled by American Water-Works & Guarantee Co., Ltd., Pittsburgh, Pa. Des. Engr., W. S. Kuhn, Pittsburgh, Pa. Const. Engr., J. H. Purdy.

Water Supply.—Mississippi river, pumping to reservoir and stand-pipe.

Pumping Machinery.—Dy. cap., 13,000,000 galls.; 9,000,000 Worthington; Blake.

Reservoir.—No data.

Stand-Pipe.—Cap., 132,500 galls.; 15 x 100 ft. Contr., T. Wagner.

Distribution.—(In '87.) *Mains*, c. i., 15¾ miles. *Services*, galv. i. Pipe and specials from Shickle, Harrison & Howard, St. Louis, Mo. *Taps*, withheld, est., 1,000. *Meters*, withheld. *Hydrants*, Chapman, 161. *Valves*, Chapman. *Pressure-recording gauge*, Edson.

Consumption, est., 3,500,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—(In '87). Cost, $275,000. Cap. stock, $250,000. Bonded debt, $250,000. Int., 6%. Ann. op. exp., withheld, est., $10,000. Ann. rev.: total, withheld, est., $30,000. Hydrant rental, $100.

Management.—Prest., W. S. Kuhn, Pittsburgh, Pa. Secy., S. M. Highlands. Treas., J. H. Purdy. Supt., F. M. Horner.

NOTE.—No report for '89 can be obtained.

ELGIN, *Kane Co.* (Pop., 8,787; est., 21,000.) On Fox river, which furnishes water-power. Incorp. city. Partially sewered. Has electric lights.

History.—Built in '87-8 by city; put in operation May, '88. Engr., Chester B. Davis, Chicago. Assist. Engrs., W. C. Hawley, T. F. Witmar.

Water Supply.—Well and Fox river, filtered, pumping to stand-pipe or direct.

Pump-Well.—Diam., 18 ft.; depth, 24 ft. Connected with river by 24-in. pipe.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two Worthington, low-pressure, dup. *Boilers:* two; from Oil City (Pa.) Boiler Works.

Filter.—Dy. cap., 2,500,000 galls.; American.

Force Main.—Diam., 16 ins.

Stand-Pipe.—Cap., 475,000 galls.; 30 x 95 ft.; steel, on pedestal of concrete, faced with stone, 20 ft. high. Contrs., for pipe proper, Shickle, Harrison & Howard, St. Louis, Mo.

Distribution.—*Mains*, 6 to 24-in. c. i., 16 miles. *Services*, lead. Pipe and specials from Cincinnati & Newport Iron & Pipe Co., Newport, Ky.; trenching and pipe-laying done by Carothers & Hutzed, Ann Arbor, Mich. *Taps*, 591. *Meters*, Thompson, Worthington, Hersey, Crown, 37. *Hydrants*, Ludlow, 196. *Valves*, Eddy.

Consumption, 432,000 galls. *Pressure:* Ordinary, 90 lbs. Fire, 100 lbs.

Financial.—Cost, $162,000. Cap. stock, $86,000. Bonded debt, $86,000. Int., 5%. Ann. op. exp., $5,000. Ann. rev.: consumers, $8,000.

Management.—Water Comrs. Prest., G. P. Lord. Secy., G. R. Wilson. Supt., R. R. Parkin.

EL PASO, *Woodford Co.* (Pop., 1,390; est., 2,500.) Is 17 miles from Bloomington. Settled in '50; incorp. city in '66.

History.—Built in '82 by city after plans by Dr. Frederic Cole.

Water Supply.—Well, pumping to tank and direct. Well is 10 ft. diam. for 60 ft., then has 3 3-in. holes bored 54 ft. deeper.

Pumping Machinery.—Dy. cap., about 90,000 galls.; Smith & Vaile dup.; driven by Eclipse windmill, and lifts water 58 ft.

Tank.—Cap., 36,100 galls.; 16 x 24 ft.; wood, on timber trestle.

Distribution.—(In '87.) *Mains*, Wyckoff, 2½ miles. *Services*, iron. *Taps*, 35 *Meters*, none. *Hydrants*, Holly, 20.

Consumption, about 6,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 65

Financial.—(In '87.) Cost, $12,000. No debt. Ann. op. exp., $50. Ann. rev.: consumers, not given, est., $800.

Management.—(In '88.) Supt., E. S. Paul.

NOTE.—No report for '89 can be obtained.

EUREKA, *Woodford Co.* (Pop., 1,183; est., 1,500.) Incorp. No sewers or electric lights.

History.—Built in '86 by village. Des. Engrs., Fairbanks, Morse & Co., Chicago. Const. Engr., Geo. W. Anthony, Eureka. No general Contr.

Water Supply.—Well, pumping to tank or direct. Well is 12 ft. diam., 60 ft. deep.

Pumping Machinery.—Dy. cap., 260,000 galls.; Worthington.

Tank.—Cap., 36,100 galls.; 16x24 ft.; on brick tower 60 ft. high.

Distribution.—*Mains*, w. i., 4,500 ft. *Services*, not given. *Taps*, 38. *Meters*, none. *Hydrants*, kind not given, 9.

Consumption, 15,000 galls. *Pressure:* Ordinary, 40 lbs.

Financial.—Cost, $6,500. Bonded debt, $5,000, running 20 years. Int., 6%. Ann. op. exp., $150; one-half of income paid to Tile & Brick Factory for use of their pump and engine. Ann. rev.: consumers, $300.

Management.—Trustees. A. J. Youngblood, Chas. Hamilton. Treas., G. W. Darst.

EVANSTON, *Cook Co.* (Pop., 4,400; est. 10,000.) On Lake Michigan, 12 miles north of Chicago. Has electric lights.

History.—Built in '74 by town. Engrs. and Contrs., Holly Mfg. Co., Lockport, N. Y.

Water Supply.—Lake Michigan, by direct pumping.

Intake.—Perforated plate iron box, filled with gravel, is located 1,000 ft. from shore in 21 ft. of water, and connected with pump-well by 16-in. pipe with flexible joints.

First intake was gravel-filled crib extending 125 ft. into lake, intended to act as filter. In '76 bar formed outside crib, and it was impossible to pump more than an hour at a time.

Pumping Machinery.—Dy. cap., 7,000,000 galls.; 2,000,000 Holly quadruplex, 5,000,000 Gaskill horizontal.

Distribution.—*Mains*, c. i., 15 miles. *Services*, galv. i. *Taps* (in '81), 400. *Meters*, none. *Hydrants*, Cregier, 100. *Valves*, Ludlow.

Consumption, 1,200,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 90 lbs.

Financial.—(In '87.) Cost, $118,000. Bonded debt, $32,000. Int. 6%. Ann. op. exp., $6,000. Ann rev.: total, $12,000.

Management.—(In '88.) Address Saml. Peeney or J. J. Adams.

NOTE.—No report for '89 could be obtained.

FAIRBURY, *Livingston Co.* (Pop., 2,140; est., 2,700.) Has manufactories. Incorp. No sewers or electric lights.

History.—Built in '87 by village.

Water Supply.—Source not given, pumping to tank.

Pumping Machinery.—Dy. cap., 57,600 galls.; kind not given.

Tank.—Cap., 60,000 galls.; 75 ft. high.

Distribution.—*Mains*, 8 in., kind not given, 1 mile. *Taps*, 18. *Meters*, none. *Hydrants*, kind not given, 12.

Consumption, 1,500 galls. *Pressure*, 75 to 175 lbs.

Financial.—Cost, $8,000. Debt, $5,000. Int., 6%. Ann. op. exp., withheld, est., $500. Ann. rev.: withheld, est., $500.

Management.—Prest., G. B. Dowing. Secy., T. S. O. McDowell. Supt., A. Brown.

FORT SHERIDAN (*Highland P. O.*) *Lake Co.* (Pop., fort planned for 600 men at first.) U. S. military post.

General Description.—Construction begun in '89, to be finished about June, '90, by U. S. Government. Crosby P. Miller, Capt. and A. Q.-M., in charge. Supply, Lake Michigan, pumping to 100,000-gall. tank or stand-pipe. Pump, 1,500,000-gall. Gordon. Est. cost, $102,000.

FREEPORT, *Stephenson Co.* (Pop,, 8,516; est., 12,000.) On Pecatonica river, on bluff 70 to 100 ft. above river. Has manufactories. Settled in '35. Incorp. Has sewers and electric lights.

History.—Built in '82 by Freeport Water Co. Engr., J. D. Cook, Toledo, O. Contr., Nathan Shelton, Omaha, Neb.

Water Supply.—Artesian wells and Pecatonica river, latter being filtered, pumping to stand-pipe and direct. There are 17 3-in. wells, and one 2-in., averaging about 42 ft. in depth, driven 20 ft. apart. Each well is connected to a 16-in. c. i. suction pipe. Wells were driven under direction of Supt. Josel. River supply is from well in gravel, near bank, 25 ft. diam., 28 ft. deep.

Pumping Machinery.—Dy. cap., 4,000,000 galls.; Knowles pumps.

Stand-Pipe.—Cap., 115,500 galls.; 15 x 88 ft.; plate-iron; on ground 107 ft. above river, and 175 ft. above center of city.

Distribution.—*Mains*, 16 to 4-in. c. i., 14¼ miles. *Services*, not given. *Taps*, 510. *Meters*, 40. *Hydrants*, Mathews 102. *Valves*, Eddy.

Consumption, 1,000,000 galls. *Pressure:* Ordinary, 80 lbs. Fire, 100 lbs.

Financial.—Cost, $251,000. Cap. stock, $150,000. Bonded debt, $132,000. Sinking fund, $3,000. Int., 6%. Ann. op. exp., withheld, est., $10,000. Ann. rev.: consumers, withheld, est., $15,000; city, $10,160. Hydrant rental, $80 to $100.

Management.—Prest., Nathan Shelton, Omaha, Neb. Treas., O. Bidwell. Supt., F. E. Josel.

FULTON, *Whiteside Co.* (Pop., 1,733; est., 2,500.) On Mississippi river. Incorp. No sewers or electric lights.

History.—Built in '87-8 by village for fire protection. Des. Engr., E. P. Wheeler. Const. Engr., V. B. Briggs. Contrs., Eclipse Wind Engine Co., Beloit, Wis. **Water Supply.**—Well, pumping to reservoir and direct. **Pumping Machinery.**—Dy. cap., 600,000 galls.; Deane. *Boiler:* Erie. **Reservoir.**—Cap., 100,000 galls.; 15 x 80 ft., x 12½ ft. deep. **Distribution.**—*Mains*, kal. i., 1¼ miles. *Taps*, 1. *Meters*, none. *Hydrants*, kind not given, 16. *Consumption* and *Pressure*, not determined. **Financial.**—Cost, $11,000. Debt, $9,000. Int., 5% Ann. op. exp. and rev., not determined. **Management.**—City Clerk, A. W. Bastian.

GALENA, *Jo Daviess Co.* (Pop., 6,451; est., 9,000.) On Galena river, 4 miles from Mississippi. Manufactures furniture, carriages, lumber, farm implements and has marble and stone works and iron foundries. No sewers. Has electric lights.

History.—Built in '86-7 by Galena Water Co. Engr., E. S. Alexander, Chicago.

Water Supply.—Artesian well 8 ins. diam. x 1,520 ft. deep, pumping to stand pipe and direct.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two comp., cond. Smedley. *Boilers:* two, 4½ x 14-ft., steel.

Stand-Pipe.—Cap., 129,250 galls.; 20 x 55 ft. Contrs., Iowa Iron Works, Dubuque.

Distribution.—*Mains*, c. i., 6 miles. *Services*, kal. i. Pipe and specials from Shickle, Harrison & Howard, St. Louis, Mo.; trenching and pipe-laying done by A. W. Stevens, Logansport, Ind. *Taps*, withheld, est., 300. *Meters*, none. *Hydrants*, Ludlow, 74. *Valves*, Ludlow.

Consumption, 300,000 galls. *Pressure*: Ordinary, 90 to 100 lbs. Fire, 100 to 125 lbs.

Financial.—Cost, $75,000. Bonded debt, $65,000. Int., 6%. Ann. op. exp., withheld, est., $3,000. Ann. rev.: consumers, withheld, est., $5,000; city, $3,000. Hydrant rental, $40

Management.—Prest., A. D. Howard. Secy., H. S. Raymond. Supt., W. E. French.

GALESBURG, *Knox Co.* (Pop., 11,437; est., 15,000.) On level ground. Engaged in manufacturing and trade. Has electric lights.

GALESBURG WATER CO.'S WORKS.

History.—Built in '83. Engr., F. E. Josel. Previous to this city had laid 1¼ miles of mains, which were sold conditionally to Co. Franchise was granted to Nathan Shelton.

Supply proved to be of a bad quality a few months after works were put in, and upon examination it was found that it had been taken from a creek which received drainage from slaughter houses and other sources. City annulled contract, and case went to Supreme Court; Judge Gresham sustained city's action on ground of non-compliance, and title to old mains was vested in city.

Since the discovery of the pollution of the supply Co. has sunk artesian wells.

No report has been given since '84, when the following was submitted:

Water Supply.—Well, 15 ft. in diam., 70 ft. deep, pumping to stand-pipe, with artesian well supplying reservoir for reserve.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two Worthington.

Stand-Pipe.—Cap., about 170,000 galls.; plate iron, 15x132 ft.

Distribution.—(In '84.) *Mains*, 16 to 6-in. c. i., 8 miles. *Services*, w. i. *Taps*, 175. *Hydrants*, 82.

Financial.—(In '84.) Cap. stock, $150,000. Hydrant rental, $100.

Management.—(In '88.) Prest., Nathan Shelton, Omaha, Neb. Secy. and Treas., T. R. Sylvanus. Supt., W. M. Flanagan.

PRESENT CITY WORKS.

General Description.—Since contract was annulled and ownership of the 1¼ miles of old mains vested in city, supply of water has been obtained by the city, ½ mile of mains laid; pumping station is now operated, and some consumers supplied. *Mains*, 2 miles. *Hydrants*, 24. For fire pressure an arrangement has been made with the C., B. & Q. R. R. Complete works are projected. Feb. 17, '90, it was undecided whether supply would be from surface or tubular wells. City Clerk, J. C. Stevens. Chn. Fire and Water Com., Chas. Waste.

GENESEO, *Henry Co.* (Pop., 3,518; est., 5,000.) On level ground, 23 miles from Rock Island. Settled in '37, incorp. town in '55 city in '65. Has sewers. No electric lights.

History.—Built in '79-82 by city.

Water Supply.—Artesian wells, direct pumping from reservoir. First well was 6 ins. in diam. x 800 ft. deep principal yield being from stratum 120 ft. below surface. Second well was sunk in 87, and yields 275,000 gals. daily.

Receiving Reservoir.—Cap., about 50,000 galls.; 22 x 40 ft., x 10 ft. deep; receives water from second well.

Pumping Machinery.—Dy. cap., 250,000 galls.; two Walker, Dayton; was used to lift water from first well. *Boilers:* two horizontal, tubular.

Distribution.—*Mains*, c. i. 8 miles. *Services*, w. i. Pipe and specials from Columbus (O.) Pipe Co., and R. D. Wood & Co., Philadelphia, Pa.; trenching done by J. Carroll and pipe-laying by A. White & Co. *Taps*, 62. *Meters*, none. *Hyarants*, Chapman, Perkins, Mathews, 55.

Consumption, 30,000 galls. *Pressure:* Ordinary, 20 lbs. Fire, 90 lbs.

Financial.—Cost, $36,510. Debt, $10,000. Int., 5%. Ann. op. exp., $2,500. Ann. rev.: consumers, $900.

Management.—City Clerk, L. C. Campbell. Supt., A. Moncreuth.

GREENVILLE, *Bond Co.* (Pop., 1,886; est., 2,000.) Incorp. No sewers or electric lights.

History.—Built in '84 by town. Des. Engr., G. R. Briggs. Masonry and foundations put in by village.

Water Supply.—Well, 22 ft. diam., x 45 ft. deep, by direct pumping.

Pumping Machinery.—Dy. cap., 144,000 galls.; two Blake, double-acting.

Distribution.—*Mains*, 8 and 6-in. kal. i., 2 miles. *Services*, w. i. Pipe and specials furnished and laid by E. H. Gray, Chicago *Taps*, 75. *Meters*, none. *Hydrants*, Bailey, 22. *Valves*, Eddy. *Gate-boxes*, Brigham & Morgan.

Consumption, 100,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 175 lbs.

Financial.—Cost, $25,000. Bonded debt, $16,000. Int., 6%. Ann. op. exp. $1,500. Ann. rev.: consumers, $1,200.

Management.—Secy., Ward Reid. Supt., V. McLain.

HAVANA, *Mason Co.* (Pop., 2,118; est., 3,500.) Incorp. city. Sewers projected for '90. No electric lights.

History.—Built in '89-90 by city; put in operation about Mar. 15. Des. Engr., F. Wm. Raeder, St. Louis. Supt. of Construction—Van Studdeford. Contr., Guido Jaeger, Rich Hill, Mo.

Water Supply.—"Gravel beds under ground," pumping direct and to standpipe.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; two 500,000 Deane dup., comp.

Tank.—Cap., 20,000 galls.; steel, 15 x 36 ft.; on brick tower.

Distribution.—*Mains*, c. i., about 2½ miles. *Services*, w. i., asphalt-coated.

Pressure: Ordinary, 35 to 45 lbs. Fire, 125 lbs.

Financial.—Cost, $22,000. Debt, $13,500.

Management.—No data. Report, Mar. 3, '90.

HILLSBORO, *Montgomery Co.* (Pop., 1,803; est., $2,000.)

History.—Built in '88 by village. Des. Engr., W. R. Coats, Kalamazoo, Mich. Const. Engr., Wm. E. Hinsdale, of Eclipse Wind Engine Co., Beloit, Wis.. Contrs. Original plans were changed to lessen cost.

Water Supply.—Well, 20 ft. diam. x 21 ft. deep, pumping to tank; direct pumping used in case of fire.

Pumping Machinery.—Dy. cap., 500,000 galls.; Worthington. *Boiler:* 4⅞ x 16 ft., steel, from Pond Engineering Co., St. Louis, Mo.

Tank.—Cap., 50,000 galls.; cypress, on 70-ft. trestle.

Distribution.—(In '87.) *Mains*, 8 to 4 in. c. i., 1¾ miles; from Shickle, Harrison & Howard Iron Co., St. Louis, Mo. *Services*, not given. *Taps*, withheld, est., 50. *Hydrants*, Mathews, 24. *Valves*, Galvin. *Valve-boxes*, from A. W. Morgan & Co., Buffalo, N. Y.

Consumption, not given. *Pressure*, 200 lbs., specified.

Financial.—(In '87.) Cost, $15,000. Other details not determined.

Management.—City Clerk (in '88), Geo. C. Pryce.

NOTE.—No report could be obtained for '89.

HOOPESTON, *Vermillion Co.* (Pop., 1,272; est., 2,800.) Manufactures tile, flax-tow, and has canning factories. Incorp. No sewers or electric lights.

History.—Built in '88 by village. Engr. and Contr., George C. Morgan, Chicago.

Water Supply.—Deep well and reservoir, pumping to tank.

Pumping Machinery.—Dy. cap., 640,000 galls.; two Deane.

Tank.—Cap., 30,000 galls.; Morgan's special water tower.

Distribution.—*Mains*, 8 to 4 in. c. i., 3 miles. *Taps*, 90. *Meters*, none. *Hydrants*, Morgan, 24. *Valves*, Crane.

Financial.—Cost, $16,500. Debt, $12,900. Int., 5% Ann. op. exp., about $700. Ann. rev.: consumers, $700.

Management.—Chn. Com., A. T. Catherwood. Mayor, A. H. Trego.

HOPEDALE, *Tazewell Co.* (Pop. of township, 1,354; of village, est. 900.)

General Description.—Built in '88-9 by village, [probably] for fire protection. Contr., C. M. Honghton, Delaware. Pumping machinery from Robt. London, Bloomington. Water pumped to 50,000-gall. tank. Cost, $4,000. Debt, $2,500. Int. 7%. Village Clerk, Ben S. Ford.

JACKSONVILLE, *Morgan Co.* (Pop., 10,927; est., 12,000.) On Mauvaisterre creek. Has manufactories. Incorp. "Very poor" sewers. Has electric lights.

History.—Built in '73-4 by city. Des. Engr., E. S. Chesbrough. Const. Engr., E. Wolcott.

Water Supply.—Surface water, pumping from impounding to distributing reservoir and direct. Surface water is from 4 sq. m. of rolling prairie, under cultivation. In Dec., '89, artesian well was under construction, sunk about 2,000 ft.

Dam.—Across ravine to form impounding reservoir; earth, 18 ft. high, length not given.

Dam and Impounding Reservoir.—Cap., 80,000,000 galls. Site was excavated, and when full reservoir is in no place less than 12 ft. deep. Dam, of earth, 18 ft. high; length, not given.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two Worthington, dup. There were formerly two direct-acting pumps built by Chas. B. Hardwick.

Distributing Reservoir.—Cap., 2,500,000 galls.; 86 ft. above city and 133 ft. above pumps; circular, with earth embankments; inner slopes and bottom lined with clay and paved with brick.

Distribution.—*Mains*, 10 to 4-in. c. i., 13½ miles. *Services*, lead. *Taps*, 476. *Meters*, 206. *Hydrants*, Ludlow, Galvin, 97. *Valves*, Ludlow, Galvin.

Consumption, about 400,000 galls. *Pressure:* Ordinary, 45 lbs. Fire, 160 lbs.

Financial.—Cost, $200,000. Debt, $105,500. Int., 6%. Ann. op. exp (in '87), $4,670. Ann. rev.: consumers (in '87), $8,812.

Management.—Three Comrs. Secy., W. E. Capps. Supt., D. C. Fry.

JERSEYVILLE, *Jersey Co.* (Pop., 2,894; est., 4,000.) Has manufactories and electric lights.

History.—Built in '89 by city. Des. Engr., Geo. C. Morgan, Chicago. Contrs., Rockford Construction Co. (Also see Reference.)

Water Supply.—Artesian well, 2,003 ft. deep, pumping to reservoir, then pumped to tank. Contr. for well, J. P. Miller, Chicago.

Pumping Machinery.—Dy cap., 750,000 galls.; Deane.

Reservoir.—Cap., 50,000 galls.; brick.

Tank.—Cap., not given; Morgan's special tower, 135 ft. high.

Distribution.—*Mains*, 8 to 4-in. c. i., 4¼ miles. *Hydrants*, Mathews, 32. *Valves*, Eddy.

Financial.—Cost, $26,000.

Management.—Com. Chn., J. S. Daniels. Latest report, Sept. 20, '89.

Reference.—See *Eng. News*, vol. XXI., p. 490, for note regarding city's annulling contract with Geo. C. Morgan, Chicago.

JOLIET, *Will Co.* (Pop., 11,657; est.,25,000.) On bluffs on Des Plaines river, which falls 36 ft. here, affording water-power. Has large stone quarries, Bessemer Steel Works, and other manufactories. Settled in '30, incorp. city in '53. No sewers. Has electric lights.

History.—Built in '80-1 by Joliet Water Works Co. Franchise was granted to Jesse W. Starr, who had charge of construction; it provided that five streams of water should be thrown from hydrants, simultaneously, to height of 100 ft. When works were completed and tested this could not be done, and it being claimed that other requirements, also, had not been fulfilled the city revoked franchise and contracts. This action resulted in 7 years of litigation, case going from lowest to highest courts of country, and always being decided in favor of Co.

In '88 city purchased works, price having been determined by 3 arbitrators: A. Gottlieb, Chicago, for Co.; L. B. Jackson, for city; and T. J. Whitman, St. Louis, Mo., chosen by two first. Terms of purchase not given.

Water Supply.—Pond and artesian wells, pumping to stand-pipe and direct.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; 3,000,000 Gaskill horizontal-Knowles formerly in use.

Stand-Pipe.—Cap., 41,900 galls.; 7 x 145 ft.

Distribution.—*Mains*, c. i., 16 miles. *Services*, w. i., lead. Pipe and specials from R. D. Wood & Co., Philadelphia, Pa., and Dennis, Long & Co., Louisville, Ky. *Taps*, 650. *Meters* (in '86), 365. *Hydrants*, Chapman, 65.

Consumption, 1,700,000 galls. *Pressure:* Ordinary, 50 lbs. Fire, 100 lbs.

Financial.—Cost (July, '88), $186,620. Debt, $126,000. Int., 5%. Ann. op. exp. (in '87), $4,000. Ann. rev.: consumers (in '87), $7,000.

Management.—Supt., Jno. F. Gleason.

KANKAKEE, *Kankakee Co.* (Pop., 5,651; est., 8,000.) On Kankakee river, which furnishes water-power. Engaged in manufacturing and trade. Incorp. No sewers. Has electric lights.

History.—Built in '86-7 under 20-years franchise, by Kankakee Water Co. Moffett, Hodgkins & Clarke, Syracuse, N. Y., control company, and acted as Contrs., with C. F. Taylor, as Const. Engr

Water Supply.—Kankakee river, filtered, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; Gordon & Maxwell. *Boilers:* tubular. **Filter.**—No data.

Stand-Pipe.—Cap., 291,400 galls.; 20 x 124 ft.; from Sharon (Pa.) Boiler-Works. Oct. 14, '86, a week after stand-pipe was completed, and before it was filled, it was blown down by heavy gale. It was estimated that wind blew 60 miles an hour. Pipe was in highest part of city. Its foundation was of stone in cement, 22 ft. in diam. Pipe consisted of 31 rings of boiler iron, each 4 ft. high, "thoroughly riveted." Bottom rings were 11-16, and two top, 5-32 ins. thick. Six 2-in. anchor irons, 8 ft. long, were fastened to masonry foundations, and to heavy cast-iron plates on sides of pipe. When pipe fell some of the anchors were pulled out of masonry, and one broke below nut at upper end, and one in masonry.

Distribution.—*Mains*, c. i., 13 miles. *Services*, w. i. *Taps*, 526. *Meters*, none. *Hydrants*, kind not given, 111.

Consumption, 250,000 galls. *Pressure:* Ordinary, 55 lbs. Fire, 100 lbs.

Financial.—Cost, $160,000. Debt, $125,000. Int., 6%. Ann. op. exp., $3,000. Ann. rev.: consumers, $8,100; city, $5,000. Hydrant rental, $5,000, or about $45 each.

Management.—Prest., H. C. Hodgkins. Supt., Wm. S. Reed.

KEWANEE, *Henry Co.* (Pop., 2,704; est., 4,300.) Engaged in coal mining and manufacturing. Incorp. Has sewers. No electric lights.

History.—Built in '87-8 by village. Engr., Jno. A. Cole, Chicago.

Water Supply.—Well, 12 ft. diam., 31 ft. deep, direct pumping, and pumping to storage reservoir for fire protection.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; 1,000,000 and 500,000 Buffalo duplex. *Boiler:* Haxteen, from Pond Engineering Co., St. Louis, Mo.

Reservoir.—Contr., Aug. Wagner, Kewanee.

Distribution.—*Mains*, kal. i., 2¼ miles. *Services*, kal. i. Pipe and specials from National Tube Works Co., Chicago. *Taps*, not given, est., 100. *Meters*, none. *Hydrants*, Ludlow, 30. *Valves*, Walker.

Consumption, not determined. *Pressure*, 60 lbs.

Financial.—Cost, $35,000. Debt, $24,000. Int., 6%. Ann. op. exp. and rev., not determined, or withheld.

Management.—Supt., E. E. Baker. Report by B. F. Baker.

LANARK, *Carroll Co.* (Pop., 1,198; est., 1,800.)

General Descritpion.—Built in '88 by city. Direct pumping. Pump, 1,000,000 Smedley dup. *Mains*, ¾ miles. *Hydrants*, 12. *Pressure*, 45 to 150 lbs. Supt., L. Heath.

LEMONT, *Cook Co.* (Pop., 2,108; est., 4,500.) Is 25 miles from Chicago. Has large limestone quarries.

History.—Built in '84 by village, artesian well being rented. Engr., Jas. B. Kelly.

Water Supply.—Artesian well, pumping to reservoir.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; two Smith & Vaile. *Boiler:* horizontal, tubular.

Reservoir.—Cap., about 100,000 galls.; stone, at elevation of 100 ft. Village proposed to build similar reservoir in '88 at an elevation of 160 ft.

Distribution.—(In '87.) *Mains*, 4-in. c. i., 5 miles. *Services*, lead. Pipe and specials from R. D. Wood & Co., Philadelphia, Pa., and Dennis Long & Co., Louisville, Ky.; trenching and pipe-laying done by Jno. Branky. *Taps*, 200. *Meters*, none. *Hydrants*, Mathews, 25. *Valves*, Eddy.

Consumption (in '87), 80,000 galls. *Pressure:* Ordinary, 45 lbs. Fire, 70 lbs.

Financial.—(In '87.) Cost, $20,000. Debt, $2,500. Int., 6%. Ann. op. exp., $1,200. Ann. rev.: consumers, $1,600; city, none.

Management.—Village Prest., D. C. Norton.

NOTE.—No report could be obtained for '89.

LEWISTON, *Fulton Co.* (Pop., 1,771; est., 2,000.) Is 9 miles northwest of Chicago. Incorp. No sewers. Has electric lights.

History.—Built in '88 by Lewiston Water Co., in which town has an interest. Engr., Geo. C. Morgan, Chicago.

Water Supply.—Driven well, pumping to stand-pipe.

Pumping Machinery.—Cap., not given; Knowles.

Stand-Pipe.—Cap., 25,000; 12 x 36 ft.

Distribution.—*Mains*, 8 to 4-in. c. i., 5 miles; from Lake Shore Foundry, Cleveland, O. *Taps*, 100. *Hydrants*, from National Tube Works Co., Chicago, 30.

Pressure: Ordinary, 100 lbs. Fire, 150 lbs.

Financial.—Cost, $31,000. Bonded debt, $15,000. Int., 6%. Ann. op. exp. and rev., not determined, or withheld.

Management.—Prest., H. Phelps. Secy., H. C. Hassen.

LINCOLN, *Logan Co.* (Pop., 5,639; est., 8,500.) On Salt creek, in coal region. Engaged in manufacturing. Incorp. No sewers. Has electric lights.

History.—Built in '86, under 30-years franchise, by Lincoln Water-Works Co., controlled by Moffett, Hodgkins & Clarke, Syracuse.

Water Supply.—Wells, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two Gordon & Maxwell, comp., dup., cond.

Stand-Pipe.—Cap., 150,000 galls.; 16x100 ft.

Distribution.—*Mains*, c. i., 9 miles. *Services*, galv. i., lead. *Taps*, 250. *Meters*, 2. *Hydrants*, Galvin, 51. *Valves*, Scott.

Consumption, 223,856 galls. *Pressure:* Ordinary, 69 lbs. Fire, 150 lbs.

Financial.—Cost, $110,000. Debt, $85,000. Int., 6%. Ann. op. exp., $2,500. Ann. rev.: consumers, $7,200; city, $3,000. Hydrant rental, $60.

Management.—Prest., J. F. Moffett. Supt., A. J. Aldrich. All inquiries should be addressed to Moffett, Hodgkins & Clarke, Syracuse, N. Y.

LITCHFIELD, *Montgomery Co.* (Pop., 4,326; est., 6,000.) On level ground. Manufactures railway cars, machinery and flour. Settled in '54; incorp. city '59. Has sewers and electric lights.

History.—Built in '74 by town. It is unofficially reported that bonds issued by town to pay for works were beyond legal limit, 5% of its assessed valuation, and that after a time city defaulted and failed to pay int. on them. Also that bondholders were defeated in suit that terminated in U. S. Supreme Court, judgment being that the bonds were worthless. As late as '82 no payments were being made on original bonded debt of $50,000 at 8%.

Water Supply.—Shoal creek, by direct pumping from impounding reservoir. Drainage area, about 20 sq. m.

Dam and Reservoir.—Cap., not given. Dam is of earth. Area, 21 acres.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Worthington. A 750,000 Holly quadruplex formely in use.

Distribution.—*Mains*, c. i., 4 miles. *Services*, w. i. *Taps*, 120. *Meters*, none. *Hydrants*, Ludlow, White, 42.

Consumption, 250,000 galls. *Pressure:* Ordinary, 70 lbs. Fire, 100 lbs.

Financial.—Cost, $75,000. Bonded debt, "nothing;" see History. Ann. op. exp., $3,700. Ann. rev.: consumers, $3,700.

Management.—Prest. and Supt., Wm. Wilton. Secy., Jno. W. Rose.

LOCKPORT, *Will Co.* (Pop., 1,679; est., 3,500.) Is 5 miles from Joliet. Manufactures flour and paper. No sewers. Has electric lights.

History.—Built in '77 by Lockport Artesian Well Co.

Water Supply.—Artesian well, pumping to reservoir.

Pumping Machinery.—Dy. cap., 140,000 galls ; water-power.

Reservoir.—Cap., about 500,000 galls.; 40x90 ft., x20 ft. deep.

Distribution.—(In '87.) *Mains*, i., 1 mile. *Services*, lead. *Taps*, 60. *Meters*, none. *Hydrants*, Mathews, 20. *Valves*, Eddy.

Consumption and *Pressure*, withheld.

Financial.—(In '87.) Cost, $500. Cap. stock, $3,000. No debt. Ann. op. exp., $500. Ann. rev.: consumers, $150; city, $50.

Management.—Prest., J. L. Norton. Secy. and Treas., W. G. Norton. Supt., W. O. Fisher.

MATTOON, *Coles Co.* (Pop., 5,737; est., 10,000.)

History.—Built in '85 by Mattoon Clear Water Co. Des. Engr., Jas. H. Harlow. Const. Engrs. and Contrs., Jas. H. Harlow & Co., all of Pittsburgh, Pa.

Water Supply.—Kickapoo creek and wells alongside, pumping to reservoir, thence by re-pumping direct or to stand-pipe.

Pumping Machinery.—Dy. cap. (actual), 2,000,000 galls.; 750,000 Deane for pumping to reservoir; two 1,000,000 Smith & Vaile, dup., for re-pumping to stand-pipe.

Reservoir.—Cap., not given; brick and cem.

Stand-Pipe.—Cap., 160,000 galls.; 15 x 120 ft.

Distribution.—*Mains*, c. i., 6½ miles. *Services*, w. i. *Taps* (in '87), 70. *Meters*, none. *Hydrants* (in '87), 73.

Consumption (in '87), 35,000 galls. *Pressure:* Ordinary, 45 lbs. Fire, 150 lbs.

Financial.—Cost (in '86), $70,000. Bonded debt, $65,000; payable July 15, '90. Int., 6%. Ann. op. exp., withheld, est., $3,000. Ann. rev.: consumers, withheld, est., $5,000; city, $5,000 for hydrants. Hydrant rental, about $70. City pays direct to Trustee of first mortgage bond enough of hydrant rental to meet int.

Management.—Address R. H. Foote, 49 Broadway, N. Y. City.

MENDOTA, *La Salle Co.* (Pop., 4,142; est., 5,000.) Manufactures organs, flour, carriages, tiles, agricultural implements. Incorp. No sewers. Has electric lights.

History.—Built in '88, put in operation Jan. 1, '89, by town. Engr., Geo. C. Morgan, Chicago, who acted as purchasing agent for town.

Water Supply.—Artesian well, 400 ft. deep, pumping to small storage reservoir, thence to tank.

Pumping Machinery.—Dy. cap., 750,000 galls.; deep-well and high pressure, Deane dup.

Reservoir.—Cap., 144,000 galls.; 56 ft. in diam., 8 ft. deep; lined, and bottom paved with brick in cem., covered with conical roof, supported by center pier.

Tank.—Cap., 26,000 galls.; placed on Morgan's special tower, 118 ft. high.

Distribution.—*Mains*, c. i., 2 miles. *Taps*, not given. *Hydrants*, Morgan, 30. *Valves*, Crane.

Consumption, not determined. *Pressure*, not given.

Financial.—Cost, $19,000. Bonded debt, $20,000. Int., 6%. Ann. op. exp., and ann. rev., not determined.

Management.—Mayor, M. A. Wilson. Secy., G. H. Holland. Supt., D. L. Harris.

MENONK, *Woodford Co.* (Pop., 1 913; est., 2,500.) Has flouring mill, coal mine and tile works. Incorp. city. Has sewers. No electric lights

History.—Built in '87-9 by village; put in operation Aug. 1, '89. Des. Engr., P. D. Johnston. Const. Engr., Jno. Saulsburry. Contrs., Fairbanks, Morse & Co.

Water Supply.—Well, pumping to tank.

Pumping Machinery.—Dy. cap., 384,000 galls.; Smith & Vaile, dup.

Tank.—Cap., 57,600 galls.

Distribution.—*Mains*, 8 and 6-in. wood, 4,000 ft. *Taps*, not determined. *Hydrants*, Beaumont, 10.

Consumption, not determined. *Pressure:* Ordinary, 40 lbs. Fire, 80 lbs.

Financial.—Cost, $10,000. Debt, $10,000. Int., 5%. Ann. op. exp. and rev., not determined.

Management.—Mayor J. Kerrick.

MOLINE, *Rock Island Co.* (Pop., 7,800; est., 10,000.) On Mississippi river, on bottom lands about 1¼ miles wide, with bluffs back of them 150 ft. high. Has water-power and manufactories. Settled in '43; incorp. village in '53, and city in '72. Has sewers and electric lights.

History.—Built in '83 by Davis & Co.; bought by city July, '86. Engr., M. A. Gould.

Water Supply.—Mississippi river, by direct pumping. Water passes from pool, formed by dam across channel of river, through conduit to settling basin, thence by direct pumping.

Dam.—Built from Illinois shore to Rock Island by U. S. Government. Stone, 4,000 ft. long, 20 ft. high, 8 ft. wide at bottom and 4 at top, with buttresses.

Conduit.—From pool to settling basin; 18 in. c. i., 1,000 ft. long.

Settling Basin.—No data.

Pumping Machinery.—Dy. cap., 2,500,000 galls.; Deane. Knowles and Worthington were successively removed on account of demand for increased cap. *Boilers:* two, tubular, 5 x 16 ft.

Distribution.—*Mains*, c. i., 10 miles. *Services*, w. i. *Taps*, 350. *Meters*, 20. *Hydrants*, Ludlow, 152.

Consumption, 750,000 galls. *Pressure:* Ordinary, 75 lbs. Fire, 140 lbs.

Financial.—Cost, $105,000. Debt, $50,000. Int., 6%. Ann. op. exp., $5,200. Ann. rev.: consumers, $7,200.

Management.—Supt., Fred Alstulund.

MONMOUTH, *Warren Co.* (Pop. 5,000; est., 6,000.) Engaged in manufacturing. Incorp. city. No sewers. Has electric lights.

History.—Built in '88-9 by city. Put in operation Apr. 1, '89. Engr., W. W. Curtis, St. Paul, Minn.

Water Supply.—Artesian well, pumping to reservoir, thence repumped directly to mains. Well is 4 ins. in diam., 1,227 ft. deep; water stands 50 ft. below surface.

Deep-Well Pump.—Dy. cap., not given; made by Wheeler & Tappan, Chicago.

Reservoir.—Cap., 300,000 galls.; 20 x 51 ft. Contrs., Rockford Const. Co.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Holly, non-comp., dup. *Boiler:* from Peter Fawcett, Burlington, Ia.

Distribution.—(Oct. 8, '89.) *Mains*, 10 to 4-in. c. i., 5 miles. *Services*, i. and lead. Pipe and special furnished and laid by Rockford Const. Co. *Taps*, 75. *Meters*, none. *Hydrants*, Bourbon, 45.

Consumption, 55,000 galls. *Pressure:* Ordinary, 65 lbs. Fire, 140 lbs.

Financial.—(Oct. 8, '89.) Cost, $40,000. Bonded debt, $35,000. Int., 5%. Ann. op. exp., $2,160. Ann. rev.: not determined.

Management.—Chn. Com., W. W. McCullough. Report by W. A. Child.

MORGAN PARK, *Cook Co.* (Pop., 187; est., 1,500.) Incorp. Has sewers. No electric lights.

History.—Built by village in 74. Engr., C. McLennan.

Water Supply.—Artesian well, pumping to tank. Formerly open well 40 ft. deep was used. New well was bored by W. H. Gray.

Pumping Machinery.—Dy. cap., 115,000 galls.; Deane. *Boiler:* from M. H. Walker & Co. First pump was double-acting, 5x15-in. force pump, driven by 25-ft. windmill, made by the U. S. Wind Engine & Pump Co.

Tank.—Cap., 100,000 galls.; Contrs., Fairbanks, Morse & Co., Chicago. First tank had cap. of 50,000 galls., was 24x14 ft.; placed on timber trestle 24 ft. high.

Distribution.—(In '87.) *Mains*, wood and iron, 8 miles. *Services*, not given. Pipe furnished and laid by C. S. Baker & Co. *Taps*, 80. *Meters*, none. *Hydrants*, Ludlow, 4. *Valves*, Ludlow.

Consumption, 30,000 galls. *Pressure*, 40 lbs.

Financial.—Cost, $25,000. Debt, withheld; paid by special assessment. Ann. op. exp., $1,500. Ann. rev., withheld, est., $3,000.

Management.—Comrs. Prest., T. W. Goodspeed. Report by A. Wiswall.

MORRISON, *Whiteside Co.* (Pop., 1,981; est., 2,000.) Incorp. No sewers or electric lights.

History.—Built in '69 and rebuilt or extended in '82 by town. Engr. of latter work, H. G. Parish.

Water Supply.—Spring, pumping to tank, and direct in case of fire.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Worthington. *Boilers:* tubular.

Tank.—No data.

Distribution.—*Mains*, c. i., 4 miles. *Services*, w. i. *Taps*, 275. *Meters*, none. *Hydrants*, Mathews, Ludlow, 39.

Consumption, 200,000 galls. *Pressure:* Ordinary, 28 lbs. Fire, 155 lbs.

Financial.—Cost, $23,000. Debt, $7,000. Int., 5%. Sinking fund, $1,500 per annum, by taxation. Ann. op. exp., $2,000. Ann. rev.: consumers, $2,300.

Management.—City Council. Supt., H. G. Parish.

MORRISONVILLE, *Christian Co.* (Pop., 748; est., 1,200.) Manufacture tiles, flour, elevators. Incorp. No sewers or electric lights.

History.—Built in '88-9 by village. Engr., "for certain parts," F. Wm. Raeder, St. Louis, Mo. Contrs., Water, Light & Power Co., St. Louis, Mo.

Water Supply.—Well, pumping to tank and direct. Well built by village independently of other work.

Pumping Machinery.—Dy. cap., 500,000 galls.; Worthington dup. *Boiler:* from N. O. Nelson Co., St. Louis, Mo.

Tank.—Cap., 40,000 galls.; 20 x 16 ft.; cypress, on 60-ft. wooden trestle.

Distribution.—(May 14, '89.) *Mains*, 8 to 4-in. c. i., 1 mile. *Services*, galv. i., 10. Pipe and specials from Shickle, Harrison & Howard Iron Co., St. Louis. *Taps*, 10. *Meters*, 1. *Hydrants*, Ludlow, 5. *Valves*, Ludlow.

Consumption, 50,000 galls. *Pressure:* Ordinary, 33 lbs. Fire, 60 to 75 lbs.

Financial.—(May 14, '89.) Cost, $8,000. Bonded debt, $5,000. Int., 6%. Ann. op. exp. and rev., not determined.

Management.—Secy., W. E. Forbes. Supt. and Engr., A. L. McAuley.

MOUNT CARROLL, *Carroll Co.* (Pop. of township, 2,878; village, est., 2,000.) Incorp. Has sewers. No electric lights.

History.—Built in '88 by village. Contrs., U. S. Wind Engine & Pump Co., Batavia, Ill. Cost, $18,000.

Water Supply.—Well, pumping to tank.

Pumping Machinery.—Dy. cap., 750,000 galls.; Gordon.

Tank.—No data.

Distribution.—*Mains*, kind not given, 1½ miles. *Services*, not given. *Taps*, 25. *Meters*, none. *Hydrants*, kind not given, 20.

Consumption, 32,500 galls. *Pressure:* not given.

Financial.—Cost, $18,000. Debt, $1,800. Int., 6%. Ann. op. exp., $800. Ann rev.: consumers, $500; city, $100.

MOUNT PULASKI, *Logan Co.* (Pop., 1,125; est., 2,100.) Incorp. No sewers. Electric lights contemplated.

History.—Built in '82 by village, under direction of J. M. Hopkins, Supt.

Water Supply.—Well, pumping to tank.

Pumping Machinery.—Dy., cap., 350,000 galls. Hooker-Colville.

Tank.—Cap., about 50,000 galls.

Distribution.—*Mains*, 4 miles. *Services*, w. i. *Taps*, 200. *Meters*, none. *Hydrants*, Nelson, 36.

Consumption, 150,000 galls. *Pressure*, 35 lbs.

Financial.—Cost, $6,000. No debt. Ann. op. exp., $1,500. Ann. rev.: consumers, $1,200.

Management.—Comrs. Chn., John T. Schick. Supt., J. M. Hopkins.

MURPHYSBOROUGH, *Jackson Co.* (Pop., 2,196; est., 4,500.) On Muddy river, in coal region. Sewers and electric lights projected for '90; see History.

History.—Built in '90 by Murphysborough Water-Works, Electric and Gaslight Co.; to be completed about July 1. Engrs., Johnson & Fladd, St. Louis, Mo. Contr. M. T. Stookey, Belleville.

Water Supply.—Big Muddy river, pumping to stand-pipe.

Stand-Pipe.—Cap. 118,000 galls.; 15 x 150 f..

Financial.—Cost, including electric lights, est., $120,000. Bonds, $60,000. Hydrant rental $3,000 for all.

Management.—Prest., W. K. Murphy. Secy., W. Wall.

NOTE.—No further data. Latest report, Mar. 5, '90.

NORWOOD PARK, *Cook Co.* (Pop., est., 750.) Suburb of, 11 miles from Chicago.

History.—Built in '89 by village. Engr. and Contr., Geo. C. Morgan, Chicago.

Water Supply.—Artesian well, pumping from reservoir to tank.

Reservoir.—No data.

Pumping Machinery.—Dy. cap., 300,000 galls.; dup.

Tank.—Cap., not given. Morgan's special water tower.

Distribution.—*Mains*, Wyckoff, 2½ miles.

Pressure: Ordinary, 43 lbs. Fire, 80 lbs.

Financial.—Cost., est., $11,000.

Management.—No data.

NOTE.—Above subject to change, as report was made May 6, '89, prior to expected completion, July 1.

OAK PARK, *Cook Co.* (Pop., 1,888; est., 5,000.) Is 5 miles west of Chicago. Incorp. Has sewers and electric lights.

History.—Built in '85 by Cicero Water, Gas & Electric Light Co. Engr., Geo. C. Morgan, Chicago. Labor done by day.

Water Supply.—Two artesian wells, 2,000 ft. deep, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Worthington.

Stand-Pipe.—Diam. not given, 105 ft. high.

Distribution.—*Mains*, iron, 15½ miles. *Services*, lead. *Taps*, 370. *Meters*, 98. *Hydrants*, Mathews, 165. *Valves*, Crane.

Consumption, 100,000 galls. *Pressure:* Ordinary, 50 lbs. Fire, 150 lbs.

Financial.—Cost, $100,000. Cap. stock, $170,000. Bonded debt, $30,000. Int., 6%. Ann. op. exp., $5,000. Ann rev.: consumers, $6,000: city, $4,890. Hydrant rental, $30.

Management.—Prest. J. W. Scoville. Secy., C. E. Simmons. Treas., O. W. Herrick. Supt., F. W. Jackson. Pumping Engr., Jas. Henry.

OREGON, *Ogle Co.* (Pop., 1,088; est., 2,000.) On Rock river. Has some manufactories, and is summer resort.

History.—Built in '78 by village.

Water Supply.—Rock river, pumping to reservoir.

Pumping Machinery.—Dy. cap., 250,000 galls.; Blake.

Reservoir.—Cap., 1,120,000 galls.

Distribution.—(In '87.) *Mains*, c. i., 1½ miles. *Services*, w. i. *Taps*, 75. *Meters*, 5. *Hydrants*, Holly, 21. *Valves*, Eddy.

Consumption, 25,000 galls. *Pressure:* 85 lbs.

Financial.—(In '87.) Cost, $18,012. No debt. Ann. op. exp., $500. Ann. rev.: consumers, $550; city, none.

Management.—Fire and Water Com. of 3. Secy., Frank Burchell. Supt. and Engr., T. Jackson.

OTTAWA, *La Salle Co.* (Pop., 7,834; est., 12,000.) On Illinois, at mouth of Fox river. Has water-power and manufactures glass goods, fire-brick, drain tile and pottery. Incorp. No sewers. Has electric lights.

History.—Built in '60 by private company for use of manufactories, surplus going to business houses. In '88 works were extended for fire protection. In '89 more extensive works were projected by two or three companies.

Water Suppy.—Springs, by gravity.

Reservoir.—Is 9 x 15 ft., x 15 ft. deep.

Distribution.—*Mains*, c. i., 4 miles. *Services*, w. i. *Taps*, 125. *Meters*, 1. *Hydrants*, none.

Consumption, 180,000 galls. *Pressure*, not given.

Financial.—Cost, withheld, est., $40,000. Cap. stock, $100,000. Ann. op. exp., withheld, est., $1,000 Ann. rev.: consumers, withheld, est., $4,000.

Management.—Prest. and Supt., J. D. Caton. Secy., C. A. Caton.

PARIS, *Edgar Co.* (Pop., 4,373; est., 5,000.) Is 19 miles from Terre Haute. Engaged in manufacturing. Incorp. Partially sewered. Has electric lights.

History.—Built in '79 by city. Engr., J. G. Briggs, Terre Haute.

Water Supply.—Ground water, direct pumping from reservoir. It is unofficially reported that later supply has been obtained from driven wells, and second reservoir built.

Reservoir.—Cap., 4,000,000 galls.; area, 1½ acres; excavated in clay and quicksand. Well 8 ft. diam. and sunk for 6 ft. below bottom of reservoir, receives suction pipes.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two Blake, dup., high-pressure, with 18 x 24-in. steam, 10-in. water cylinders.

Distribution.—*Mains*, c. i., 7 miles. *Services*, not given. *Taps*, 300. *Meters*, 2. *Hydrants*, Mathews, 60.

Consumption, 1,000,000 galls. *Pressure*, 30 to 120 lbs.

Financial.—Cost, $53,277. Bonded debt, $30,000. Int., 7%. Sinking fund, $2,800. Ann. op. exp., $5,000. Ann. rev.: consumers, $3,000. Original cost, $39,706.

Management.—City Council. City Clerk, A. H. Geohegan.

PARK RIDGE, *Cook Co.* (Pop., 457; est., 800.) Is 15 miles from Chicago. Incorp. Partially sewered. Has electric lights.

History.—Built in '87 by village, making use of well sunk in '75-6. Engr. and Contr., Geo. C. Morgan, Chicago.

Water Supply.—Artesian well about 1,500 ft. deep, pumping to tank. Well is lined for 200 ft. with 6, and for 600 ft. with 3½-in. pipe. Water stands about 8 ft. below surface.

Pumping Machinery.—Dy. cap., 350,000 galls.; Deane, dup., 200,000 Worthington; latter added in '89.

Tank.—Cap., 30,000 galls.; Morgan's special tower, consisting of iron tank on brick substructure.

Distribution.—*Mains*, 6 and 4-in. Wyckoff wood, 3,640 ft. *Services*, not given. *Taps*, 35. *Meters*, 1. *Hydrants*, Morgan, 3. *Valves*, Crane.

Consumption, 2,000 galls. *Pressure:* Ordinary, 30 lbs. Fire, 100 lbs.

Financial.—Cost, $6,000. Debt, $2,500. Int., 6%. Ann. op. exp., $689. Ann. rev.: $338.

Management.—Secy. of Com., Saml. Cochran. Supt., H. Hassman.

PAXTON, *Ford Co.* (Pop., 1,725; est., 2,500.)

History.—Built in '87-8 by village. Contrs., Fairbanks, Morse & Co., Chicago, with P. D. Johnson as Supt. of Const.

Water Supply.—Artesian well, pumping to tank.

Pumping Machinery.—Dy. cap., 40,000 galls.

Tank.—Cap., 60,000 galls.; 18 x 24 ft., on tower 80 ft. high.

Distribution.—*Mains*, wood, 1½ miles. *Services*, iron. *Taps*, withheld, est., 50. *Meters*, not given. *Hydrants*, Beaumont, 4.

Consumption, not given. *Pressure:* Ordinary, 35 to 50 lbs.

Financial.—Cost, $10,000. Bonded debt (given in '88 report), $3,500. Int., 7%. Ann. op. exp., withheld, est., $500. Ann. rev.: consumers, withheld, est., $500.

Management.—Supt., Frank Cook.

PEKIN, *Tazewell Co.* (Pop., 5,993; est., 7,000.) On Illinois river, 10 miles below Peoria. Incorp. Has sewers and electric lights.

History.—Built in '86 by Pekin Water-Works Co. Engr., E. S. Alexander, Chicago. Contrs., Lamb & Raymond, Chicago.

Water Supply.—Driven well, pumping to tank.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; Blake. *Boiler:* 5x16 ft.

Tank.—Cap., 129,250 galls.; 20x55 ft., on 80 ft. of masonry.

Distribution.—*Mains*, c. i., 11 miles. *Services*, galv. i. *Taps*, 300. *Meters*, 2. *Hydrants*, Ludlow, 111. *Valves*, Ludlow.

Consumption, 350,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 120 lbs.

Financial.—(In '87.) Cost, $100,000. Cap. stock, $100,000. Bonded debt, $100,000. Int., 6%. Ann. op. exp., $4,000. Ann. rev.: consumers, $5,000; city, $4,385. Hydrant rental (in '89), $40 for first 100; $35 for additional.

Management.—Prest., C. A. Lamb, Chicago. Secy. and Supt., Henry Lautz.

PEORIA, *Peoria Co.* (Pop., 29,259; est., 45,000.) On Illinois river, on high ground surrounded by bluffs. Permanently settled in '19. Has electric lights.

History.—Built in '67-8 by city. Sold in '89 to Moffett, Hodgkins & Clarke, Syracuse, N. Y., who organized the Peoria Water Co. Contrs., Holly Mfg. Co., Lockport, N. Y. Works are being extended in '90.

Water Supply.—*Old:* Illinois river, by direct pumping. *New:* will be wells, pumping to stand-pipes.

Pumping Machinery.—Dy. cap, 3,500,000 galls.; Dean, Cameron, high and low-pressure Worthington. Two Holly rotary pumps were used at first, and a 3,000,000 Dean crank erected in '75. 4,000,000 Worthington in '80. It is is not stated which, f any, pump has been abandoned.

Stand-Pipes.—Cap., 889,000 galls.; two, with cap. of 449,000 and 440,000, one 30 x 85 ft., other, 25 x 120 ft. Contrs., Porter Mfg. Co., Syracuse, N. Y. Built in '90.

Disiribution.—*Mains*, c. i., 45 miles. *Services*, lead. *Taps* (in '87), 3,000. *Meters*, 12. *Hydrants*, Holly, Ludlow, Chapman, Galvin, 367.

Consumption, 4,000,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 125 lbs.

Financial.—Cost (in '87), $450,000. Debt, $450,000. Int., 6%. Ann. op. exp. (in '87), $32,000. Ann. rev.: consumers, $34,000. Op. exp. for '90, $19,989; rev., do., $24,805.

Management.—Address Co., or Moffett, Hodgkins & Clarke, Syracuse, N. Y.

Reference.—Tenth Census U. S., Vol. XVII., Water Supply of Cities, p. 56.

PETERSBURG, *Menard Co.* (Pop., 2,332; est., 2,500.) On Sangamon river. No sewers. Has electric lights.

History.—Built in '87-8 by village; committee modified plans made by W. R. Coats, Kalamazoo, Mich. Contr., D. Fisher.

Water Supply.—Four 8-in. tube wells, pumping to tank.

Pumping Machinery.—Dy. cap., 480,000 galls.; Buffalo.

Tank.—Cap., 185,000 galls.; 30 x 35 ft.

Distribution.—*Mains*, 10 to 4-in. c. i., 1¾ miles. *Services*, not given. *Taps*, 50. *Meters*, 1. *Hydrants*, Bourbon, 22. *Valves*, Bourbon.

Consumption, 80,000 galls. *Pressure*, 70 lbs.

Financial.—Cost, $23,500. Debt, $19,000. Int., 5%. Ann. op. exp., $900. Ann. rev.: consumers, $1,500.

Management.—Council, Mayor, A. Thompson.

PITTSFIELD, *Pike Co.* (Pop., 2,104; est., 3,000.) Has manufactories.

History.—Built in '87-8 by town, principally for fire protection and street sprinkling. Des. Engr., Geo. C. Morgan. Const. Engr., Chester B. Davis, under immediate direction of Scott Myrick. All of Chicago. Labor done by town. **Water Supply.**—Surface well, with 2,000-ft. artesian well sunk from its bottom, pumping to tank. Contrs. for artesian well, Laney & Churchill, Indianapolis, Ind. **Pumping Machinery.**—Not given; deep-well, 3¼ x 42 ins. **Tank.**—Cap., 39,750 galls.; 15 x 36 ft.; iron, on 68-ft. tower. Contr., Wm. Drake, Springfield. **Distribution.**—*Mains*, 8 and 6-in., 1 mile; from Shickle, Harrison & Howard Iron Co., St. Louis, Mo. *Hydrants*, 10. *Consumption*, not determined. *Pressure*, 50 lbs. **Financial.**—Cost, $15,000. Debt, $3,000. Int., 7%. Ann. op. exp., about $250. Ann. rev.: none. **Management.**—Town Board. Report by Scott Wike.

POLO, *Ogle Co* (Pop., 1,819; est., 2,200.)

General Description.—Water for fire protection supplied from the tank of Ill. Central R. R. Co., through pipe on Main St., and 3 hydrants.

PULLMAN, *Cook Co.* (Pop., est., 12,500.) Near Chicago. Consists of shops, factories and dwellings, owned by Pullman Palace Car Co. Has sewers. No electric lights.

History.—Built in '80-2 by Pullman Palace Car Co. Engr., Benezette Williams.

Water Supply.—Hyde Park division Chicago water-works, pumping direct and in case of fire to tank. Water is metered.

Force Main.—Diam., not given; length, 6 miles.

Tank.—Cap., 500,000 galls.; 56 x 31 ft.; on tower 200 ft. high.

Distribution.—*Mains*, c. i., 16 miles. *Services*, lead. *Taps*, 1,035 [excessive number of taps reported for '88 MANUAL.] *Meters* (in use), 30. *Hydrants*, Bailey, Ludlow, 131. *Valves*, Eddy, Ludlow.

Consumption, 1,278,332 galls. *Pressure*, 75 lbs.

Financial.—Cost, $176,161. No debt. Ann. op. exp., $18,718. Ann. rev.: domestic, $12,946; shops, &c., $13,148.

Management.—Prest., Geo. M. Pullman. Engr., D. Doty.

QUINCY, *Adams Co.* (Pop., 27,268; est., 36,000.) On magnesian limestone bluffs, 165 ft. above Mississippi river. Engaged in manufacturing and trade. Settled in '21; incorp. city in '40. Has sewers and electric lights.

History.—Built in '73 by private Co., and now owned by L. & W. B. Bull. Des. Engr., Edw. Prince.

Suit brought by Co. against city for debt of $48,000 was decided against former in Supreme Court, on the ground that city had no right to contract debt, as it had exceeded limitation of 5 per cent. on value of taxable property. Final settlement is not reported.

Water Supply.—Mississippi river, pumping to reservoir. Water formerly pumped to two tanks.

Intake Pipe.—Georgia pine, 30-in., 1,500 ft. long, extending to 13 ft. of water. A 20-in. pipe was used until present one was laid in '88,

Pump-Well.—Lined with brick and cem., and extends to rock; bottom covered with 1 ft. cem. mortar. In '82 pump-well in use was 30 ft. in diam., double-walled. Water passed through wire screen around ¾ of outer annular space to inner well; this well has been abandoned.

Pumping Machinery.—Dy. cap., 6,500,000 galls.; 5,000,000 Gordon & Maxwell; 1,500,000 Worthington, dup., comp., cond.

Force and Supply Main.—Diam., 29 ins.

Reservoir.—Cap., 20,000,000 galls.; 300 x 450 ft., 22 ft. water. Banks of yellow clay, rolled in 6-in. layers; no heart wall; 26 ft. high, 15 ft. thick on top, 90 to 110 ft. at base. Slopes 1½ to 1; inner paved with 1 ft. dry rubble, or 1 ft. clay puddle, latter extending over bottom. *Discharge-pipes:* 20-in. influent and effluent-pipe; 16-in. drain-pipe, having 12-in. upright connection, 22 ft. high, for overflow. Reservoir does not leak. Built in '81. Engrs., Edw. Prince. No Contr. Cost, $25,000.

Distribution.—*Mains,* c. i., 22 miles. *Services,* galv. i. *Taps,* 1,400. *Meters,* 190. *Hydrants,* Mathews, 160. *Valves,* Ludlow, Galvin.

Consumption, 750,000 galls. *Pressure,* 35 lbs.

Financial.—Cost, withheld, est., $350,000. No stock, bonds or debt. Ann. op. exp., withheld, est., $10,000. Ann. rev.: consumers, withheld, est., $30,000; city, $10,000. Hydrant rental, $66.66.

Management.—Proprietors, L. & W. B. Bull. Supt., W. B. Bull.

RIVERSIDE, *Cook Co.* (Pop., 450; est., 1,000.) Near Chicago.

History.—Built by village prior to '89.

Water Supply.—Artesian well, pumping to tank. Well, 1,370 ft. deep, 3½ ins. in diam. at bottom. May, '89, contract for new well, 2,000 to 2,200 ft. deep, 5 ins. in diam. at bottom, was let to Grey Bros., Milwaukee. Jan. 7, '60, well was not quite finished.

Tank—Cap., 42,000 galls.; 12 x 50 ft., on 60 ft. brick tower.

Financial.—Cost, about $20,000; new well, about $5,000 additional. Bonded debt, about $20,000.

Management.—Com. Chn., Jas. D. Raynolds. Reports, June 7, '89, Jan. 7, '90.

NOTE.—No further data.

ROCHELLE, *Ogle Co.* (Pop., 1,893; est., 2,000.) On Kaite river in rolling country. Incorp. No sewers or electric lights.

History.—Built in '77, rebuilt in '80 by village. Des. Engr., Geo. C. Morgan, Chicago, Ill.

Water Supply.—Spring in an abandoned quarry, direct pumping.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Worthington. *Boilers:* two 75-H. P., horizontal, tubular.

Distribution.—*Mains,* c. i., 2.3 miles. *Services,* w. i., lead. *Taps,* 89. *Meters,* none. *Hydrants,* Holly, 38. *Valves,* Poet.

Consumption, 50,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 120 lbs.

Financial.—Cost, $26,000. No debt. Ann. op. exp., $1,800. Ann. rev.: consumers, $675.

Management.—Com. of three. Secy., Wm. Stocking. Supt. E. E. Spooner.

ROCK FALLS, *Whiteside Co.* See Sterling.

ROCKFORD, *Winnebago Co.* (Pop., 13,129; est., 22,500.) On both sides of Rock river, which at this point is crossed by dam 6 ft. high, built for water-power. Engaged in manufacturing. Settled in '34; incorp. city in '52. Has sewers and electric lights.

History.—Built in '74-5 by city. Des. Eng., Birdsall Holly, Lockport, N. Y. Const. Engr., S. P. Crawford, Rockford. Labor done by city.

Water Supply.—Five artesian wells, by direct pumping. Wells take their supply from the Potsdam sandstone, and are from 1,300 to 2,000 ft. deep. First one was sunk in '85, before which water was taken from Rock river through filter 25 ft. diam. This was filled with sand and charcoal, and passed 800,000 galls a day, but did not work well. Before artesian wells were put down, well 50 ft. diam. x 45 ft. deep was sunk in gravel.

Pumping Machinery.—Dy. cap., 7,000,000 galls.: 3,000,000 Holly quadruplex, 4,000,000 Gaskill horizontal. *Boilers:* three, 5 x 16-ft. tubular.

Distribution.—*Mains*, c. i., 37½ miles. *Services*, w. i., lead. Pipe and specials from R. D. Wood & Co., Philadelphia, Pa., and Dennis Long & Co., Louisville, Ky. *Taps*, 2,000. *Hydrants*, Holly, Mathews, 263. *Valves*, Eddy, Galvin.

Consumption, 1,963,942 galls. *Pressure:* Ordinary, 50 lbs. Fire, 150 lbs.

Financial.—Cost, $384,942. Debt, $92,500. Int., 5%. Ann. op. exp., $11,310. Ann. rev.: consumers, $20,896. Op. exp. for '80 were $8,792, and rev., $7,274.

Management.—Supt., Jno. T. Lakin.

ROCK ISLAND, *Rock Island Co.* (Pop. 11,659; est. 17,000.) On Mississippi river. Engaged in manufacturing, coal mining and trade. Settled in '30; incorp., city in '49. Has sewers and electric lights.

History.—Built in '71-2 by city; rebuilt '81-2. Contrs., Holly Mfg. Co., Lockport, N. Y.

Water Supply.—Mississippi river, by direct pumping.

Intake.—C. i., 24-in., extending from main channel 2,100ft. to stone basin 30 ft. diam. x 28 ft. deep, having cross-wall with screens.

Pumping Machinery.—Dy. cap., 5,000,000 galls.; 2,000,000 Holly rotary and gang pumps, and 3,000,000 Holly quadruplex, erected in '82.

Distribution.—*Mains*, c. i., 19 miles. *Services*, w. i., lead. *Taps*, 1,200. *Meters*, 20. *Hydrants*, Holly, Ludlow, Perkins, 125.

Consumption, 2,000,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 140 lbs.

Financial.—Cost, $285,000. Debt, $50,000: $25,000 at 8, $25,000 at 5%. Ann. op. exp., $9,136. Ann. rev.: consumers, $16,751.

Management.—Supt., Jno. A. Murrin.

ROGERS PARK, *Cook Co.* (Pop., 529; est., not given). Incorp. Sewers contemplated. No electric lights.

History.—Built in '89 by Rogers Park Water Co. Engr., C. B. Davis. Contr., G. C. Morgan. Both of Chicago.

Water Supply.—Lake Michigan, pumping to stand pipe.

Intake Pipe.—Diam., 16 ins.

Pumping Machinery.—Dy. cap., 2,500,000 galls.; kind not given.

Stand-Pipe.—Cap., 84,600 galls.; 12 x 100 ft.

Distribution.—(Aug. 1, '89.) *Mains*, 12 to 6-in., kind not given, 6¼ miles. *Taps*, 105. *Meters*, 10. *Hydrants*, kind not given, 61.

Consumption, not determined. *Pressure*, not given.

Financial.—Cost, $70,000. Debt, $46,000. Int., 6%. Ann. op. exp. and rev., not determined. Hydrant rental, av., $55.

Management.—Prest., H. E. Keeler. Secy., Chas. Howard. Treas., W. A. Partridge. All of Chicago. Supt., Wm. Burnham.

SANDWICH, *De Kalb Co.* (Pop., 2,352; est., 3,000.) On level ground. Settled in '33; incorp. village in '60, city in '72. No sewers or electric lights.

History.—Built in '83 by city. Des. Engr., W. C. Brown.

Water Supply.—Well, pumping to stand-pipe and direct in case of fire. Well is in gravel, 14 ft. diam. x 28 ft. deep, walled with brick in cem.; dy. yield, about 400,000 galls.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Worthington, 18½ x 10-in., steam, 10½-in. water cylinders. *Boiler:* 54-H. P., vertical.

Stand-Pipe.—Cap., 84,600 galls.; 12 x 100 ft.; ½ to 3-16-in. material. On masonry foundation 25 ft. diam. at base, 15 at top, and 9 ft. thick. Built by Excelsior Iron Works, Chicago.

Distribution.—*Mains*, kal. i., 3½ miles. *Services*, galv. i. Pipe from National Tube Works, McKeesport, Pa. *Taps*, 80. *Meters*, 1. *Hydrants*, Ludlow, 32.

Consumption, 28,800 galls. *Pressure:* Ordinary, 50 lbs. Fire, 125 lbs.

Financial.—Cost, $30,000. Debt, $15,000. Int., 6%. Ann. op. exp., $1,500. Ann. rev.: consumers, $900; city, $2,900.

Management.—Supt., L. D. Smith.

SAVANNA, *Carroll Co.* (Pop., 1,000; est., 5,000.) On Mississippi river. Incorp. No sewers or electric lights.

History.—Built in '86 by town. Engr., G. E. Buch. Contrs., Northwestern Water & Gas Supply Co. Both of Minneapolis, Minn.

Water Supply.—Well on island in Mississippi river, filtered, pumping to reservoir. Thirty 3-in. pipes are sunk into bottom of well, and connected into large wooden drum, where suction takes water.

Filter.—Water passes through sand into large well.

Pumping Machinery.—Dy. cap., 700,000 galls.; Deane, dup., 16 x 10-in. steam, 9-in. water cylinders. *Boiler:* from Iowa Iron Works, Clinton.

Reservoir.—Cap., 750,000 galls.; on elevation of 225 ft.

Distribution.—*Mains,* 10 to 4-in. kal. i., 4 miles; from National Tube Works, McKeesport, Pa. *Services,* w. i. *Taps,* 79. *Meters,* none. *Hydrants,* Ludlow, 19. *Valves,* Ludlow.

Consumption, 100,000 galls. *Pressure,* 80 lbs.

Financial.—Cost, $24,226. Debt, $15,500. Int., 5%. Ann. op. exp., $1,300. Ann. rev.: consumers, $1,100.

Management.—Secy., F. S. Greenleaf. Supt., J. S. Hunt.

SHELBYVILLE, *Shelby Co.* (Pop., 2,939; est., 3,500.) On Kaskskia river in mining district. Has manufactories. Incorp. No sewers. Has electric lights.

History.—Built in '85-6 by Shelbyville Water Co., under 20-years franchise. Co. operates electric lights. Eng., S. H. Lockett, N. Y. City. Asst. Engr., J. M. Walker, Lawrence, Kan. Contrs., Comegys & Lewis, N. Y. City.

Water Supply.—Kaskaskia river, to infiltration well, thence pumping to standpipe and direct. Suction pipe connects directly with river.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two 1,000,000 Worthington comp., dup. *Boilers:* two Whittier, 50-H. P., tubular.

Stand-Pipe.—Cap., 110,000 galls.; 12½ x 130 ft.: boiler steel; from Shickle, Harrison & Howard Iron Co., St. Louis, Mo.

Distribution.—*Mains,* 12 to 4-in. c. i., 7 miles. *Services,* c. i., lead. *Taps,* 450. *Meters,* 1. *Hydrants,* Ludlow, 50. *Valves,* Ludlow.

Consumption, 200,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 160 lbs.

Financial.—Cost, $100,000. Bonded debt, $100,000: $80,000, 1st; $20,000, 2nd mortgage. Int., 6%. Ann. op. exp., $2,000. Ann. rev.: consumers, $6,000; city, $3,000. Hydrant rental, $60.

Management.—Prest., C. Whann. Secy. and Treas., C. B. Ludwig. Both of N. Y. City. Mgr., H. G. Wright.

SOMONAUK, *De Kalb Co.* (Pop., 587; est., 800.) Builds windmills. Incorp. village. Sewers reported. No electric lights.

History.—Built in '89-90 by village. Engr., C. V. Stevens. Contrs., Clark & Co. All of Somonauk.

Water Supply.—Well, pumping to tank.

Pumping Machinery.—Dy. cap., 80,000 galls.; double-acting force pump, driven by windmill.

Tank.—Cap., 80,000 galls.

Distribution.—*Mains,* 6-in. c. i., 1 mile. *Hydrants,* 25.

Pressure: Ordinary, 40 lbs. Fire, 80 lbs.

Financial.—Cost, $12,000. Bonded debt, $1,000. Int., 6%.

Management.—Com. Chn, H. Wright. Latest report, Jan. 6, '90.

SOUTH EVANSTON, *Cook Co.* (Pop., 1,517; est., 3,000.) Incorp. Has sewers and electric lights.

History.—Built in '84 by village and extended or rebuilt in '88. Engr., Geo. C. Morgan, Chicago. Contr. for masonry and buildings, C. T. Bartlett, Evanston.

Water Supply.—Lake Michigan through inlet pipe, pumping to tank. Water formerly taken by gravity from flowing artesian well 1,602 ft. deep, 6 ins. diam. for 1,236, 5 ins. for 366 ft. Water rose 24 ft. above surface.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; two Deane. *Boilers:* stee flue, with 4-ft. shell.

Tank.—Cap., 30,000 galls. Morgan's special water tower, tank on trestle.

Distribution.—*Mains*, c. i., 9 miles. *Services*, galv. i. *Taps*, 325. *Meters*, 4. *Hydrants*, Chapman, 66. *Valves*, Chapman.

Consumption, 750,000 galls. *Pressure:* Ordinary, 35 lbs. Fire, 110 lbs.

Financial.—Cost, $65,000. Bonded debt, $10,000. Int., 6%. Ann. op. ex., $1,620. Ann. rev.: consumers, $3,000.

Management.—Chn. Water Board, T. E. Briezt. Secy., W. G. Norkett. Supt. and Pumpg. Engr., Jno. Watson.

SPRINGFIELD, *Sangamon Co.* (Pop., 19,743; est., 30,000.) On prairie. 5 miles from Sangamon river. Settled in '22; incorp. city in '40. Has sewers and electric lights.

History.—Built in '66 by city; extended in '88. Des. Engr., Henry Earnshaw, Cincinnati, O. Labor is done by city.

Water Supply.—Sangamon river, through filter galleries, pumping to stand-pipe and reservoir. Water was first taken from river to pump-well through conduit 80 ft. long. Supply becoming insufficient, well was sunk 50 ft. diam., 53 ft. deep, and in '88 a filter gallery was connected with well.

Filter Gallery.—Through bed of water-bearing gravel; 900 ft. long, about 25 ft. below surface; about ⅔ necessary supply was furnished by gallery. Extension of 1,000 ft. was proposed in '89.

Pumping Machinery.—Dy. cap., 7,000,000 galls.; two Worthington, one low, one high-pressure.

Stand-Pipe.—Is 3 ft. in diam. and 70 ft. high.

Reservoir.—Cap., 4,000,000 galls.

Distribution.—*Mains*, 15 to 3-in. c. i., 33 miles. *Services*, w. i., lead. Pipe and specials from Dennis Long & Co., Louisville, Ky. *Taps*, 1,580. *Meters*, 70. *Hydrants*, Morgan, Chapman, Galvin, Ludlow, 147.

Consumption, 2,598,478 galls. *Pressure*, 15 to 25 lbs.

Financial.—Cost, about $580,000. Debt, $450,000. Int., 8%. Ann. op. exp., about $15,000. Ann. rev.: consumers, $30,268; misc., $249; city, $7,284.

Management.—Three Comrs. Prest., H. O. Bolles. Secy., H. A. Beecher. Supt., Peter Berriman.

STERLING and ROCK FALLS, *Whiteside Co.* (Pop.: Sterling, 5,087; est., 6,500; Rock Falls, 894; est., 1,800.) On both sides of Rock river, which furnishes good water-power used in manufacturing. Sterling partially sewered. Have electric lights.

History.—Built in '86 by Sterling Water Co., under 25-years franchise; extended in '87 to Rock Falls. Des. Engr., A. H. Howland, Boston, Mass. Const. Engr., H. F. Dunham, Cleveland, O. Contrs. for work at Sterling, Eastern Const. Co., Portland, Me. Labor at Rock Falls done by day.

Water Supply.—Artesian wells, 1,003 ft. deep, and Rock river, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 4,000,000 galls.; two, 2,000,000 Deane, dup., direct-acting; one being high-pressure, other comp., with independent condenser. *Boilers:* from Allen & Son, Worcester, Mass.

Stand-Pipe.—Cap., 235,000 galls.; 20x100 ft.; from Tippett & Wood, Phillipsburgh, N. J.

Distribution.—*Mains*, c. i., 13¼ miles, 1 mile being in Rock Falls. *Services*, w. i., lead. Pipe and specials, from Dennis, Long & Co., Louisville, Ky. *Taps*, 386. *Meters*, Frost, 12. *Hydrants*, Coffin, 134; 122 in Sterling, 12 in Rock Falls. *Valves*, Coffin. *Pressure-recording gauge*, Edson.

Consumption, 200,000 galls. *Pressure:* Ordinary, 40 to 60 lbs. Fire, 70 to 120 lbs.

Financial.—Cost, $300,000. Bonded debt, $150,000. Int., 6%. Ann. op. exp., $4,000; ann. int., $9,000. Ann. rev.: consumers, $7,000; cities, $6,270. Hydrant rental, $46.66 for 120 in Sterling, $55.83 for 12 in Rock Falls; $35 for additional, either town.

Management.—Prest., A. H. Howland, 71 Equitable Building, Boston, Mass. Secy., H. C. Ward. Supt., W. J. Watson.

STREATOR, *La Salle Co.* (Pop., 5,137; est., 15,000.) On Vermillion river in coal fields. Incorp. city. Has sewers and electric lights.

History.—Built in '86-7 by Streator Aqueduct Co., under 30-years franchise. Engrs. and Contrs., Goodhue & Birnie, Springfield, Mass.

In '82 city sunk artesian well 2,196 ft., reaching vein of saline water in Potsdam sandstone, which rose 40 ft. above ground. About ½ mile wooden pipe was laid and 6 hydrants set, water being used for street sprinkling and fire protection.

Water Supply.—Tube wells and Ottar creek, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two 1,500,000 Gaskill horizontal

Stand-Pipe.—Cap., 294,000 galls.; 20 x 125 ft.; from R. F. Hawkins, Springfield Mass.

Distribution.—*Mains*, c. i., 20 miles. *Services*, galv. i. Pipe and specials from Cincinnati & Newport Iron & Pipe Co.; trenching and pipe-laying done by R. B. Carothers; both of Newport, Ky. *Taps*, 525. *Meters*, 21. *Hydrants*, Chapman, 140. *Valves*, Chapman.

Consumption, 500,000 galls. *Pressure:* Ordinary, 55 lbs. Fire, 130 lbs.

Financial.—(In '87.) Cost, $275,000. Cap. stock, $175,000. Bonded debt. $175,000. Int., 6%. Ann. op. exp., withheld, est., $5,000. Ann. rev.; consumers, withheld, est., $17,000; city, $6,350. Hydrant rental, $45 for 112, $35 for additional.

Management.—Prest., L. M. Bronson, N. Y. City. Secy., T. M. Birnie, Springfield, Mass. Treas., Wm. Birnie, do. Supt., F. D. Ferguson.

SULLIVAN, *Moultrie Co.* (Pop., 1,305; est., 2,000.) Incorp. city. Partially sewered. No electric lights.

General Description.—Built in '88 by city; put in operation in Nov. Contr., U. S. Wind Engine & Pump Co., Batavia. Supply, well, pumping with windmill, to about 50,000-gall. tank. Cost, about $10,000. No debt. Ann. op. exp., nominal. City Clerk, Jno. P. Lilly. Chn., J. T. Dedman. Report, Mar. 5, '90.

SYCAMORE, *De Kalb Co.* (Pop., 3,028; est., 4,000.) Manufactures farming implements. Incorp. No sewers. Has electric lights.

History.—Built in '76, extended in '87, by village. Des. Engr., Chester B. Davis, Chicago.

Water Supply.—Surface well, pumping to stand-pipe and direct. Well, 25 ft. diam., 30 ft. deep, with four 7-in. pipes driven 35 ft. in bottom. A 3-in. boring was made until water was found, and well dug about this as center.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Blake.

Stand-Pipe.—Cap., 179,000 galls.; 15 x 135 ft.; from Shickle, Harrison & Howard Iron Co., St. Louis, Mo.

Distribution.—*Mains*, c. i., 2 miles. *Services*, lead and iron. *Taps*, 60, *Meters*, 3. *Hydrants*, kind not given, 25.

Consumption, 35,000 galls. *Pressure:* Ordinary, 75 lbs. Fire, 120 lbs.

Financial.—Cost, $45,000. Bonded debt, $25,000. Int., 5%. Ann. op. exp., $1,200. Ann. rev.: $900.

Management.—Supt., Jno. B. Whalen.

TAYLORVILLE, *Christian Co.* (Pop., 3,237; est., 3,000.) Has manufactories and electric lights.

History.—Built in '86 by town. Engr., Geo. C. Morgan, Contrs., for labor, local.

Water Supply.—Well, 30 ft. in diam. and depth., and tube wells, pumping to tank and direct. Tube wells were sunk in '88.

Pumping Machinery.—Dy. cap., 3,750,000 galls.; 3,000,000, Deane, high-pressure, 750,000 Gaskill non-comp.; latter added in '89.

Tank.—Cap., 30,000 galls.; Morgan's special water tower.

Distribution.—(In '87.) *Mains*, c. i., Wyckoff wood, 6½ miles. *Services*, not given. *Taps*, not given, est., 150. *Meters*, none. *Hydrants*, Morgan, Ludlow, 39. *Valves*, Ludlow.

Consumption and *Pressure*, not given.

Financial.—(In '87.) Cost, $28,000. Debt, $17,000. Int., 6%. Ann., op. exp., not given, est., $2,000. Ann. rev.: consumers, $1,100.

Management.—Report by Jno. Perry.

NOTE.—No report could be obtained for '89.

URBANA, *Champaign Co.* See Champaign.

VENICE, *Madison Co.* (Pop., 612; est., 800.) On Mississippi river. Incorp. No sewers or electric lights.

History.—Put in operation Jan. 1, '89, by village. Engr., Lucas Pfifenberger.

In '86 mains for fire protection were laid by village, connection having been made with private line.

Water Supply.—Mississippi river, pumping to tank.

Pumping Machinery.—Dy. cap., 500,000 galls.; two Deane.

Suction Pipe.—Dimensions not given. Obstructed by deposits of sand at rise of river.

Tank.—Cap., 29,150 galls.; 15 x 22 ft.; from Cheeseman & Co., St. Louis, Mo.

Distribution.—*Mains*, 6-in., 1½ miles; from Clarkson & Co., St. Louis, Mo. *Taps*, 9. *Hydrants*, kind not given, 6.

Consumption, 1,000 galls. *Pressure*, not given.

Financial.—Cost, $13,000. Bonded debt, $7,000. Int., 6%. Ann. op. exp., $1,000. Ann. rev.: withheld, est., $150.

Management.—Trustees. Clerk, C. S. Youree.

WARSAW, *Hancock Co.* (Pop., 3,105.) On Mississippi river. Manufactures, barrels, flour and woolen goods. Incorp. No sewers. Has electric lights.

General Description.—Built by city in '87, for fire protection. Contrs., Water, Light & Power Co., St. Louis. Supply, artesian well. *Mains*, ¾ mile. *Hydrants*, 8. Cost, about $2,000. Ann. op. exp., $100.

WASHINGTON, *Tazewell Co.* (Pop., 1,397; est., 1,500.) Engaged in manufacturing.

History.—Built in '88-9 by village. Engr. and Contr., Geo. C. Morgan, Chicago.

Water Supply.—Driven wells, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., not given; Deane, dup.

Tank.—Cap., 21,000 galls.; 11 x 36 ft.

Distribution.—*Mains*, wood, 2¼ miles. *Services*, iron.

Pressure: Ordinary, 40 lbs.

Financial.—Cost, $15,000. Bonded debt, $15,000. Int., 6%.

Management.—Not organized. Report by F. W. Hops, City Clerk.

NOTE.—Not completed at time of report. Sept. 30, '89.

WAUKEGAN, *Lake Co.* (Pop., 4,021; est., 5,600.) On a bluff 80 ft. above and overlooking Lake Michigan, 36 miles north of Chicago. Has various manufactories. Settled in '34; incorp. city in '59. No sewers or electric lights.

History.—Built in '74 by town. Labor done by day.

Water Supply.—Three flowing artesian wells, by gravity. First well is 1,134 ft. deep, and water rises from it 65 ft. above surface. Rock was encountered in first well at depth of 180 ft., to which point a 4-in. pipe was inserted. This pipe corroded and was replaced in '81. First well discharges into small brick reservoir, 20 ft. sq. and deep, built half above ground.

Distribution.—*Mains*, c. i., about 6 miles. *Services*, not given. Pipe and specials from Cincinnati & Newport Iron & Pipe Co., Newport, Ky., and Addyston (O.) Pipe Works. *Taps*, about 250. *Meters*, none. *Hydrants*, kind not given, 40.

Consumption, not given. *Pressure*, 16 lbs.

Financial.—Cost, about $25,000. No debt. Ann. op. exp., $700. Ann. rev.: consumers, $1,000.

Management.—Town Clerk, A. B. Palmer.

YORKVILLE, *Kendall Co.* (Pop., 365; est., 1,150.) On Fox river. Engaged in manufacturing and trade. Incorp. No sewers or electric lights.

History.—Built in '87 by village. Engr. and Contr., Geo. C. Morgan, Chicago.

Water Supply.—Springs, 1½ miles from village, by gravity.

Reservoir.—Cap., about 200,000 galls.; 50 x 100 ft. deep.

Distribution.—*Mains*, 6 and 4-in. Wyckoff, 2 miles. *Services*, iron. *Taps*, 200. *Meters*, none. *Hydrants*, kind not given, 15.

Consumption, 1,000 galls. *Pressure:* Ordinary, 85 lbs.

Financial.—Cost, $7,000. Debt, $5,550. Int., 6%. Ann. op. exp., none. Ann. rev.: consumers, $300.

Management.—Village Trustees. Prest., P. Framm.

Water-Works Projected with Fair Prospects of Construction.

AVONDALE, *Cook Co.* (Pop., est., 1,500.)

Poposed Works.—Supply to be secured from Chicago water-works in '90. Money to be raised by direct taxation. Address Wm. R. Northway, City Engr. of Chicago.

BELVIDERE, *Boone Co.* (Pop., 2,951; est., 5,000.) Has various manufactories and electric lights.

Proposed Works.—City to build. Supply, artesian well, pumping to stand-pipe Nothing definite decided April 14, '90.

CARROLLTON, *Greene Co.* (Pop., 1,934; est., 2,500.) Manufactures tile and machinery.

Proposed Works.—City has let contract for artesian well to H. H. Gray & Co., Chicago. April 22, '90, vote was to be taken on the question of issuing bonds for works. Pumping to tank. Est. cost, $22,000. Report by H. Eberlin; date, Jan. 7, '90.

DU QUOIN, *Perry Co.* (Pop., 2,807; est., 5,000.) In coal region. Has manufactories. Incorp. city.

Proposed Works.—In '89 City Council proposed to grant franchise for water works, but gave one for gas-works instead, About Jan. 25, '90, J. R. Truesdale, St. Louis, Mo., who has franchise for gas works, stated that he was investigating source for water supply. Last year's plan comprised pumping surface water from pond to stand-pipe, with 4½ miles mains.

DANVILLE, *Vermillion Co.* (Pop., 733; est., 2,500.) Engaged in manufacturing and coal mining. Has electric lights.

Proposed Works.—Feby. 27, '90, Natural Gas Co. were waiting for contract with town for fire hydrants. Supply, artesian well already sunk, 1,500 ft. deep, water 6 ft. from top, pumping to stand-pipe. Est. cost, $30,000 to $50,000; cap. not secured. Prest., Jas. O. Parker. Secy., J, A. Downard.

LAKE FOREST, *Lake Co.* (Pop., 877; est., 1,000.)

Proposed Works.—Jan. 7, '90, resident stated that proposed supply was from lake, pumping to reservoir. Nothing further definitely known. Unofficially reported in Aug., '89, that Spring Forest Water Co. had been incorp. to supply this and other towns. Cap. stock, $30,000. *Incorporators:* J. T. Bowen, H. J. Cobb, H. N. Tuttle.

METROPOLIS CITY, *Massac Co.* (Pop., 2,668; est., 4,500.) On Ohio river. Has manufactories.

Proposed Works.—Metropolis Water Works Co. to build in '90. Supply, Ohio river, pumping to stand-pipe. Est. cost, $40,000. Co. not organized. Report, Jan. 8, '90.

WASHINGTON HEIGHTS, *Cook Co.* (Pop., est., 2,000.) Suburb of Chicago.

Proposed Works.—City to build in '90. Supply, artesian well. Unofficially reported about Feb. 25, '90, that plentiful supply had been secured at depth of 1,300 ft. Project described in MANUAL for '88, p. 377, fought down by Citizens' Assn.

Water-Works Projects Reported in '89 and '90, but now Indefinite.

Calumet, Cook Co. *Dallas City*, Hancock Co. *Edwardsville*, Madison Co. *Lexington*, McLean Co. *Onarga*, Iroquois Co. *Pana*, Christian Co. *Princeton*, Bureau Co.; see MANUAL for '88, p. 385; well not a success. *Sparta*, Randolph Co. *Vandalia*, Fayette Co. *Winnetka*, Cook Co.

WISCONSIN.

Water-Works Completed or in Process of Construction.

APPLETON, *Outagamie Co.* (Pop., 8,005; est., 11,000.) On both sides of Fox river, which falls 40 ft. within city limits. River here flows through valley ¼ mile wide and 50 to 65 ft. deep, with deep sides intersected by gullies. Has various manufactories. Incorp. Has sewers and electric lights.

History.—Built in '82 by Wiley Construction Co., under 20-years franchise. At end of this time provision is made for purchase of works by city. Des. Engr., E. C. Cooke, Tiffin, O.

Water Supply.—Fox river and three 6-in. artesian wells, direct pumping. First well 430 ft. deep, extends into Potsdam sandstone. Water from it contains sand, and is allowed to settle before being used. Second well sunk in '84, and third, later. Flow of the wells is decreasing.

Reservoirs.—*Old settling:* no data. *New:* cap., 2,500,000 galls.; under construction, '89.

Pumping Machinery.—Dy. cap., 5,000,000 galls.; 3 Deane, two 3,000,000, 12 x 24-in. water-power, one (probably) held in reserve. Third, 2,000,000, direct-acting, with 24 x 24-in. steam, 12-in. water cylinder. *Water-wheels:* Victor turbine; water for power comes from stone dam 700 ft. long, built by U. S. Government.

Distribution.—*Mains*, c. i. 16 miles. *Services*, galv. i. *Taps* (in '86), 800. *Meters*, 60. *Hydrants*, Mathews, 103. *Valves*, Eddy.

Consumption, 600,000 galls. *Pressure:* Ordinary, 71 lbs. Fire, 115 lbs.

Financial.—Cap. stock (in '84), $100,000. Ann. op. exp., withheld, est., $7,000. Ann. rev.: consumers, withheld: city, $7,600. Hydrant rental, $75 for first 80, and $70 for additional. All over 90 hydrants on original main, free.

Management.—Prest., C. H. Venner. Secy., J. C. Rogers. Supt., Jno. Hayes.

ASHLAND, *Ashland Co.* (Pop., 951; est., 15,000.) On Lake Superior. Engaged in iron mining and lumber industries. Incorp. Partially sewered. Has electric lights.

History.—Built in '84-5 by Ashland Water Co., under 50-years franchise. Engrs. and Contrs., Holly Mfg. Co., Lockport, N. Y.

Water Supply.—Chequamegon bay, Lake Superior, by direct pumping.

Intake Pipes.—*Old:* 16-in., extending 2,100 ft. into bay. *New:* 24-in., 4,560 ft. long; laid in '89.

Pumping Machinery.—Dy. cap., 3,000,000 galls.: two 1,500,000 Gaskill, horizontal, comp., cond. *Boilers:* two, horizontal, tubular.

Distribution.—*Mains*, c. i., 10 miles. *Services*, galv. i., lead. *Taps*, 611. *Meters*, 16. *Hydrants*, Holly, Holly-Gaskill, 90.

Consumption, 700,000 galls. *Pressure:* Ordinary, 50 lbs. Fire, 140 lbs.

Financial.—Cost, $205,935. Bonded debt, $100,000. Int., 6%. Ann. op. exp., $12,577. Ann. rev.: consumers, $13,475; city, $5,400. Hydrant rental, $100 for 54, and $60 for 18.

Management.—Prest., T. T. Flagler, Lockport, N. Y. Secy., Wm. Reinecke, Louisville, Ky. Treas., H. H. Flagler, Lockport, N. Y.

BARABOO, *Sauk Co.* (Pop., 3,266; est., 5,000.) On Baraboo river, which affords water-power. Incorp. Has sewers and electric lights.

History.—Built in '86-7, under 30-years franchise, by Baraboo Water-Works Co., controlled by Moffett, Hodgkins & Clarke, Syracuse, N. Y., Engrs. and Contrs.

Water Supply.—Springs, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two Deane, dup., 11x12-in. water-power.

Stand-Pipe.—Cap., 275,000 galls.; 30x52 ft.; bottom 130 ft. above town, top 250 ft. above the pump. Contrs., Riter & Conley, Pittsburgh, Pa.

Distribution.—*Mains*, c. i., 9½ miles. *Services*, w. i. Pipes and specials from Warren Foundry & Machine Co., Phillipsburgh, N. J.; laid by city. *Taps*, 292. *Meters*, 4. *Hydrants*, Holly, Ludlow, 84. *Valves*, Ludlow.

Consumption, 60,730 galls. *Pressure:* Ordinary, 106 lbs. Fire, 150 lbs.

Financial.—Cost, $130,000. Debt, $100,000. Int., 6%. Ann. op. exp., $1,000. Ann. rev.: consumers, $4,800; city, $3,460. Hydrant rental, about $40.

Management.—Prest., J. F. Moffett. Secy., Chas. T. Moffett. Supt., J. W. Reade.

BAYFIELD, *Bayfield Co.* (Pop., 564; est., 2,500.) On Bayfield Harbor, Lake Superior. Engaged in fishing, quarrying and lumbering. Has sewers and electric lights.

History.—Built in '86 by Bayfield Hydraulic Co. Des. Engr., E. F. Glover, Const. Engr., R. D. Pike.

Water Supply.—Springs, by gravity.

Dams and Reservoirs.—Cap., 350,000 galls. When dams are raised to heights mentioned below, cap. will be about 1,500,000 galls., and elevation of 120 ft. Two reservoirs formed by stone masonry dams. *Dam No. 1:* about 80 ft. long, 8 ft. high 2 ft. thick at top, 10 at bottom. Outer wall vertical, inner slopes 1 to 1. It is proposed to enlarge this and raise it to height of 12 ft. Built in Oct., '86. Cost, $1,000. *Dam No. 2:* about 80 ft. long, 7 ft. thick at top, 17 at base. Outer side batters 18 ins.; inner slopes 1 to 1 to within 3 ft. of bottom, from which point it is vertical. It is proposed to raise this 4 ft. Built Sept., '89. Cost, $2,500. Engr. for both, D. F. Glover; Contr., L. J. Burbank.

Distribution.—*Mains*, iron, 2¾ miles. *Services*, iron. *Taps*, 75. *Meters*, none. *Hydrants*, Holly, 15.

Consumption, not given. *Pressure*, 50 lbs.

Financial.—Cost, $25,000. Cap. stock and bonds (in '87), $50,000. Ann. op. exp., $500. Ann. rev.: consumers, $1,260; city, $1,500. Hydrant rental, $96.

Management.—Prest., A. Tate. Secy., F. W. Denison. Treas., F. Fisher. Supt., D. F. Glover.

BEAVER DAM, *Dodge Co.* (Pop., 3,416; est., 4,500.) Incorp. Has sewers and electric lights.

History.—Built in '88 by Moffett, Hodgkins & Clarke, Syracuse, N. Y., with E. G. Ferris as Const. Engr.

Water Supply.—Springs, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two Worthington.

Stand-Pipe.—No data.

Consumption, 40,000 galls. *Pressure:* Ordinary, 65 lbs. Fire, 65 to 100 lbs.

Financial.—Cost, $125,000. Debt, $100,000. Int., 6%. Ann. op. exp., $1,500. Ann. rev.: consumers, est., $6,000; city, $3,400.

Management.—Prest., E. G. Ferris. Supt., Geo. L. Camp.

BELOIT, *Rock Co.* (Pop., 4,790; est., 6,500.) On Rock river, which furnishes water-power for manufacturing purposes. Incorp. No sewers Has electric lights.

History.—Built in '85 by Beloit Water-Works Co. Des. Engr., M. M. Moore, of Fairbanks, Morse & Co., Chicago, Ill., the Contrs. Const. Engr., J. R. Kinley, Chicago, Ill.

Water Supply.—Well, 30 ft. diam. x 40 ft. deep, pumping to tank and direct.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two 1,000,000 Smith & Vaile, comp., dup. *Boilers:* two, steel.

Tank.—Cap., 100,000 galls.; on stone tower, 85 ft. high; Contrs., Eclipse Wind Engine Co., Beloit.

Distribution.—*Mains*, c. i., 8 miles. *Services*, iron, lead. Pipe laid by C. E. Gray, Chicago, Ill. *Taps*, 425. *Meters*, 20. *Hydrants*, Mathews, 75. *Valves*, Chapman.

Consumption, 500,000 galls. *Pressure:* Ordinary, 45 lbs. Fire, 80 lbs.

Financial.—Cost, $95,000. Cap. stock (in '87), $50,000. Bonded debt, $80,000. Int., 6%. Ann. op. exp., $2,500. Ann. rev.: consumers, $4,500; city, $5,000. Hydrant rental, $75.

Management.—Prest., J. B. Peet. Secy. and Treas., C. B. Salmon. Supt., W. H. Wheeler.

BLACK RIVER FALLS, *Jackson Co.* (Pop., 1,427; est., 3,500.) On Black river. Engaged in manufacturing. Incorp. No sewers. Has electric lights.

History.—Built in '86-7 by town. Engrs., Loweth & Curtis, St. Paul, Minn. Contrs. for masonry, brick buildings and stand-pipe, Price Mfg. Co.; for other labor and material, Philip Buehner, St. Paul, Minn.

Water Supply.—Forty-eight driven wells, 2-in. points, pumping to stand-pipe. Prior to '89 supply was from creek, filtered.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Gordon & Maxwell dup. *Boilers:* tubular, steel.

Stand-Pipe.—Cap., 150,000 galls.; 16 x 100 ft.; contract sublet to Riter & Conley Pittsburgh, Pa.

Distribution.—*Mains*, c. i., 2½ miles. *Services*, galv. i. *Taps*, 86. *Meters*, 4. *Hydrants*, Galvin, 13. *Valves*, Galvin.

Consumption, 50,000 galls. *Pressure*, 100 lbs.

Financial.—Cost, $25,000. Bonded debt, $20,000. Int., 5%. Sinking fund, $5,000. Ann. op. exp., $1,165. Ann. rev.: consumers, $1,100.

Management.—Prest., A. Erickson. Secy., J. E. Benson. Supt., E. J. Greenlee.

BURLINGTON, *Racine Co.* (Pop., est., 2,200.) On Fox River. Has water-power. Manufactures tile, brick and other articles. Incorp. village. No sewers. Has electric lights.

History.—Construction was to begin Mar. 15, '90, and works were to in be operation July 1, well having been sunk previously. Des. Engr., W. T. Goodhue, Milwaukee. Const. Engr. and Contr., Geo. C. Morgan, Chicago.

Water Supply.—Artesian well, pumping to stand-pipe. Well sunk in '89; 1,008½ ft. deep; Jan., '90, was throwing water 30 ft. above surface.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Barr dup.

Stand-Pipe.—Cap., 70,000 galls.; 20 x 30 ft.

Distribution.—*Mains*, 8 to 4-in. c. i., 2.6 miles. *Hydrants*, Morgan, 28. *Valves*, Crane.

Financial.—Cost, est., $20,000. Bonds, authorized, $20,000.

Management.—Village Clerk, H. E. Zimmermann.

NOTE.—Subject to correction, as report was made Mar. 5, just before beginning construction.

CHIPPEWA FALLS, *Chippewa Co.* (Pop., 3,982; est., 13,000.) On Chippewa river, which furnishes water-power. Incorp. Has sewers and electric lights.

History.—Built in '85 by Moffett, Hodgkins & Clarke, Syracuse, N. Y., Engrs. and Contrs.

Water Supply.—Chippewa river, filtered, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; kind not given.

Filter.—No data.

Stand-Pipe.—Cap., 367,000 galls.; 25 x 100 ft.

Distribution.—*Mains*, c. i., 11 miles. *Services*, galv. i. *Taps*, 650. *Meters*, 43. *Hydrants*, kind not given, 128.

Consumption, 120,000 galls. *Pressure*, not given.

Financial.—Cost, $300,000. Debt, (in '87), $130,000. Int., 6%, Ann. op. exp., $4,000. Ann. rev.: consumers, $7,200; city, $6,800. Hydrant rental, $55 for first 100, $50 for additional.

Management.—Prest., H. W. Phelps, Minneapolis, Minn. Secy., L. M. Newman. Supt., H. B. Shamp.

DARLINGTON, *La Fayette Co.* (Pop., 1,372; est., 2,000.) On Pecatonica river. Engaged in manufacturing and trade. Incorp. city. No sewers or electric lights.

History.—Built in '86-7 by town. Engr., G. A. Marshall, Darlington. Contrs., Eclipse Wind Engine Co., Beloit, Wis.

Water Supply.—Well, pumping to reservoir.

Pumping Machinery.—Dy. cap., 230,000 galls; Smedley.

Reservoir.—Cap., 115,000 galls.; 15 x 100 ft., x 10 ft. deep.; on bluff.

Distribution.—*Mains*, c. i., 3½ miles. *Services*, kal. i. *Taps*, 125 *Meters*, 3. *Hydrants*, Ludlow, 18.

Consumption, 12,500 galls. *Pressure:* Ordinary, 65 lbs. Fire, 65 to 100 lbs.

Financial.—Cost, $18,000. Bonded debt, $15,000. Int., 5%. Ann. op. exp., $400. Ann. rev.: consumers, $900.

Management.—Com. of 3. Chn., J. V. Swift. Treas., G. S. Anthony. City Engr., J. H. Martin.

DE PERE, *Brown Co.* (Pop., 817; est., 2,500.) On Fox river. Manufactures pig iron, freight cars, agricultural implements and drain tiles. Incorp. Has sewers. Electric lights projected.

History.—Built in '86 by Artesian Water Supply Co., under 25-years franchise. Engrs. and Contrs., Michigan Pipe Co., Bay City, Mich., A. L. Holmes, Grand Rapids, Mich.

Water Supply.—Flowing artesian well, by gravity.

Distribution.—*Mains*, Wyckoff, 4 miles. *Services*, galv. i. *Taps*, 200. *Meters*, none. *Hydrants*, Gaskill, 25.

Consumption, unknown. *Pressure*, 43 lbs.

Financial.—Cost, $14,000. Cap. stock, $25,000. No debt. Ann. op. exp., $250, Ann. rev.: consumers, $12,000; city, $535. Hydrant rental, $20 and $25.

Management.—Prest. and Supt., Wm. Armstrong. Secy., E. F. Parker. Treas., Robt. Jackson.

NOTE.—Unofficially reported latter part of '89 that works had been sold to syndicate for $100,000. Prest., Jno. W. Dyer. Secy., Hiram Knowlton. Both of Portland, Me. Treas., Jno. Hickey, Kaukauna.

DRUMMOND, *Bayfield Co.* (Pop., est., 600.) Has lumber industry and electric lights.

General Description.—Built by Rush Owen Lumber Co., date not given; probably for fire protection. Supply, Long lake, direct pumping. *Mains*, w. i., ¾ miles. *Hydrants*, Dean, 12. *Pressure:* Ordinary, 10 lbs. Fire, 100 lbs. Cost, $4,000. Supt., F. Drummond. Report, Oct. 22, '89.

EAGLE RIVER, *Oneida Co.* (Pop., est., 1,000.) In mining and lumbering and mining region.

General Description.—City began construction Dec. 15, '89, for fire protection only. Supply, river, pumping to stand-pipe. Est. cost, $10,000. Money raised by taxation. Chn. Town Board, M. Holland. Report, Jan. 8, '90.

EAU CLAIRE, *Eau Claire Co.* (Pop., 13,094; est., 22,000.) At junction of Eau Claire and Chippewa rivers. Has electric lights.

History.—Built in '85 by Eau Claire Water-Works Co. Engr., M. M. Moore. Contrs., Jas. H. Harlow & Co., Pittsburgh, Pa. In '89 improvements were made, as noted below: Engr., W. E. Hinsdale, Chicago, Ill. Contrs., Fairbanks, Morse & Co., Chicago.

Water Supply.—Wheaton springs, by gravity from impounding reservoir to pump-well, thence by direct pumping. Previous to '89 supply from Chippewa river, filtered.

Dam and Impounding Reservoir.—Cap., 20,000 000 galls.

Conduit.—About 3,200 ft. 24-in. c. i., 9,800 ft. wood pipe; latter made in trench.

Pumping Machinery.—Dy. cap.. 7,000.000 galls; Smith & Vaile water-power. *Water-wheels:* two 48-in. new American turbines, under 19-ft. head.

Filter.—Dy. cap., 1,000,000 galls.; two Hyatt. Bought for old supply; not stated whether still in use.

Distribution.—*Mains*, c. i., 26½ miles. *Services*, w. i., lead. Pipe and specials from Dennis Long & Co., Louisville Ky.; trenching and pipe-laying done by Contrs. *Taps*, 600. *Meters*, none. *Hydrants*, Mathews, 331. *Valves*, Eddy.

Consumption, 1 000,000 galls. *Pressure:* Ordinary, 70 lbs. Fire, 90 to 120 lbs.

Financial.—Hydrant rental, $54 for those on original mains and $44 on extensions. All other data withheld. *Estimates:* Cost, $250,000. Ann. op. exp., $10,000. Ann. rev.: total, $30,000.

Management.—Prest., O. H. Ingram. Secy. and Treas., C. A. Sharpe, Lake and La Salle Sts., Chicago, Ill. Supt., W. H. Willard.

FOND DU LAC *Fond du Lac Co.* (Pop., 13,094; est., 17,000.) At south end of Lake Winnebago. Incorp. Has sewers and electric lights.

History.—Built in '85 by Fond du Lac Water Co., under 20-years franchise. Contrs., Holly Mfg. Co., Lockport, N. Y.

Water Supply.—Four 600-ft. artesian wells, by direct pumping, with storage reservoir for fire protection.

Pumping Machinery.—Dy. cap., 6,000,000 galls.; two 3,000,000 Gaskill horizontal, comp.

Reservoir.—Cap., 3,000,000 galls.

Distribution.—*Mains*, c. i., 14 miles. *Services*, galv. i. *Taps*, 484. *Meters*, 5. *Hydrants*, Gaskill, 150.

Consumption, 1,000,000 galls. *Pressure:* Ordinary, 40 lbs. Fire. 100 lbs.

Financial.—Cost (in '87), $200,000. Cap. stock (in '87), $50,000. Bonded debt, $150,000. Int, 6%. Ann. op. exp., $6,000. Ann. rev.: consumers, $6,000; city, $9,800. Hydrant rental, $64 for first 140, $50 for additional.

Management.—Prest., T. T. Flagler, Lockport, N. Y. Secy., Wm. Reinecke, Louisville, Ky. Supt., W. H. Wasson.

FORT HOWARD, *Brown Co.* See Green Bay and Fort Howard.

GREEN BAY and FORT HOWARD, *Brown Co.* (Pop., Green bay, 7,404; est., 12,000. Fort Howard, 3,083; est., 6,000.) Both towns on Fox river at head of Green bay. Engaged in lumber industries and manufacturing. Partially sewered. Have electric lights.

History.—Built in '85-6 by Green Bay & Ft. Howard Water-Works Co. No Contrs. for labor.

Water Supply.—Flowing artesian wells, direct pumping; two small storage reservoirs used only in case of fire. First well 921 ft. deep; second well 911 ft.; least diam., 6 ins.; flow, 300 galls. per minute; sunk in '89.

Pumping Machinery.—Dy. cap., 8,500,000 galls.; Knowles, two 3,000,000 high-pressure, 2,500,000 comp., dup.

Storage Reservoirs.—Cap., 900,000 galls.; 300,000 and 600,000. Water kept pure by stream from wells.

Distribution.—*Mains*, w. i. and cem., 24 miles. *Services*, galv. and asphalt-coated iron. *Taps*, 800. *Meters*, none. *Hydrants*, Chapman, 214.

Consumption, 300,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 65 lbs.

Financial.—Cost, $300,000. Cap. stock (in '87), $300,000. No bonds issued to June, 88. Ann. op. exp., withheld, est., $10,000. Ann. rev.: consumers, $7,000; city, $9,075. Hydrant rental, $37.50; 30-years contract.

Management.—Prest., Eli Marvin. Secy., A. C. Neville. Treas., J. K. Miller. Supt., W. K. Harrington.

HAYWARD, *Sawyer Co.* (Pop., est., 1,500.)

History.—Built in '87-8 by private company. Engr., H. H. Harrison, Stillwater. Contr. for labor, Theo. Bunker.

Water Supply.—Namakagon river, direct pumping.

Pumping Machinery.—Dy. cap., 1,250,000 galls.; Knowles. *Boilers:* two 4 x 14-ft. tubular.

Distribution.—*Mains*, c. i., 1½ miles. *Services*, w. i. Pipe and specials from Buffalo (N. Y.) C. I. Pipe Co. *Taps*, 18. *Meters*, not given. *Hydrants*, Galvin, 18. *Valves*, Galvin.

Consumption, not given. *Pressure*: Ordinary, 35 lbs. Fire, 80 lbs.

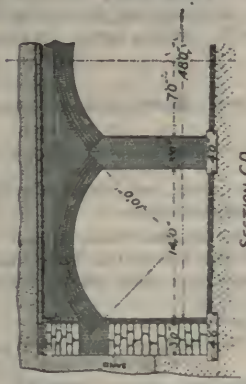
Financial.—Cost, $20,000. Debt, not given. Int., 10%. Ann. op. exp. and rev., not determined, time of report.

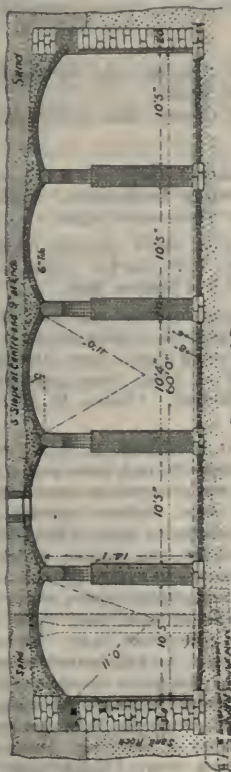
Management.—Supt. (in '88), Theo. Bunker.

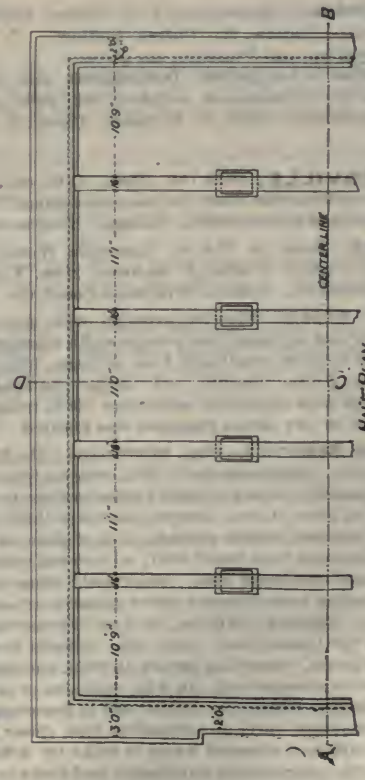
NOTE.—No report for '89 could be obtained.

HUDSON, *St. Croix Co.* (Pop., 665; est., 3,500.) Incorp. No sewers. Has electric lights.

History.—Built in '87-8 by village; put in operation Apr. 15, '88. Des. Engr., H. H. Harrison, Stillwater, Minn. Const. Engr., Jas. A. Andrews, Hudson.







Half-Plan and Sections, Covered Reservoir, Hudson, Wis.

Water Supply.—Artesian well, pumping to underground reservoir.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Blake. *Boilers:* Atlas.

Covered Reservoir.—Cap., 300,000 galls.; 48 x 60 ft. x 16 ft. deep; 256 ft. above, ⅜ miles from business section. Excavation was 18 ft. deep, in sandstone.

Inlet and discharge-pipe and waste-pipe are carried from bottom of reservoir through tunnel. *Ventilators:* 3 man-holes, 14 x 20 ins., with brick shafts carried 8 ft.

above top. Further details shown by illustrations. Built in '89. Des. Engr., W. W. Curtis, St. Paul, Minn. Const. Engr., Supt. Coon. Contr., F. Fay, Hudson. Cost, $6,000.

Distribution.—(May 6, '89.) *Mains*, 12 to 4-in., c. i., 3⅛ miles. *Services*, w. i. Pipe and specials from Ohio Pipe Co., Columbus, O.; trenching and pipe-laying done by N. N. Johnson & Son, Stillwater, Minn. *Taps*, 62. *Meters*, none. *Hydrants*, Galvin, 40. *Valves*, Galvin.

Consumption, 50,000 galls. *Pressure*, 90 lbs.

Financial.—(May 6, '89.) Cost, $34,183. Bonded debt, $24,000. Int., 4%. Ann. op. exp., $1,570. Ann. rev.: consumers, $1,200.

Management.—Five Comrs. Prest., P. McGuire Secy. and Supt., C. P. Coon.

HURLEY and IRONWOOD, *Ashland Co.* (Pop. est., 6,000.) On Montreal river, in iron mining region. No sewers. Has electric lights.

History.—Built in '87 under 30-years franchise, by Gogebic Water & Gas Supply Co.; now operated by Northwestern Water & Gas Supply Co., Minneapolis. Works not yet completed, owing to litigation between Cos. named above. Engr., G. E. Beach, Minneapolis, Minn.

Water Supply.—Montreal river, direct pumping.

Pumping Machinery.—Dy. cap., 750,000 galls.; Worthington, dup., high pressure.

Distribution.—*Mains*, kal. i., 2 miles. *Services*, w. i. *Taps*, withheld, est., 40. *Hydrants*, Ludlow, 22. *Valves*, Ludlow.

Consumption and *Pressure*, not given.

Financial.—Cost, $50,000. Debt, $40,000. Int., 6%. Ann. op. exp., withheld, est., $750. Ann. rev.: consumers, withheld, est., $800; city, $2,200.

Management.—Prest., G. E. Beach. Treas., E. E. Cooley. Both of Minneapolis, Minn.

JANESVILLE, *Rock Co.* (Pop., 9,018; est., 12,000.) On Rock river, which furnishes water-power used in manufacturing farming implements, carriages, cotton goods and other articles. Incorp. No sewers. Has electric lights.

History.—Built in '87-8 by Janesville Water Co., under 20-years franchise granted to Turner, Clarke & Rawson, Des. Engr., B. R. Clarke. Const. Engr., J. Frank Williams. Contrs., Wisconsin Const. Co. All of Boston, Mass.

Water Supply.—Flowing artesian well, pumping to stand-pipe and direct. Well is near and between pump-house and a storage reservoir to take surplus water. Well is 1,087 ft. deep, practically 8 ins. in diam., 10-in. casing having been sunk 205 ft., then 8-in. w. i. pipe inserted and boring continued at 8 ins. diam., pipe finally driven to and into calcareous sandstone, 260 ft. from surface. Contrs., W. E. Swan & Co. Sunk by city before franchise was granted.

Storage Reservoir.—Cap., 800,000 galls.; 70 x 95 ft. at bottom, 11 ft. of water. Banks of earth, with heart-wall; 10 ft. wide on top; slopes 1½ to 1, inner paved with 8-in. sandstone blocks laid at right angles to slope in 5 ins. of screened gravel, this in turn being on 5 ins. of cem. concrete for lower third of slope. Bottom covered with 5 ins. cem. concrete, which extends up ⅓ of slope, as mentioned above, then horizontally to connection with heart-wall; all covered with ¾ ins. cem. plaster, which extends up inner side heart-wall. *Heart-wall:* stone masonry in hydraulic cem., 2 ft. thick, extending some distance below natural surface and slightly above water-line. *Gate-house:* masonry, 12 ft. sq., in two compartments, division wall fitted with screens. *Pipe Connections:* 14-in. pipe extends from gate-house to dry valve-well near pump-house, connecting here with 20-in. suction-pipe. An 8-in. branch connects 14-in. pipe with artesian well. An 8-in. extension of 14-in. pipe forms circulation pipe, which discharges water near further end of reservoir when pumps are not working. When pumps start, valve on circulation pipe closes and valve on 14-in. pipe opens, admitting sufficient screened water to make up deficiency of pumping. Drain-pipe connects with reservoir and gate-house, and leads to Rock river. Upright 10-in. pipe connects with drain-pipe, forming overflow. An 8-in. pipe from dry valve-well at pump-house connects with drain-pipe. By means of drain-pipe connections and necessary valves, water from artesian well can be discharged into river; the reservoir or gate-house can be emptied at will.

Pumping Machinery.—Dy. cap., 4,000,000 galls; two 2,000,000 Blake dup., comp., cond., with 14-in. high, 28-in. low-pressure cylinders, 14-in water plungers, all 18-in. stroke. *Boilers:* 3 80-H. P., horizontal, tubular, 5 x 16½ ft.

Stand-Pipe.—Cap., about 250,000 galls.; 25 x 85 ft., on hill 100 ft. above and across river from pump-house. Contrs., Tippett & Wood, Phillipsburgh, N. J. In case of fire 10-in. valve in base of stand-pipe is closed from pumping station by electricity and direct pumping secured.

River Crossings.—Three. An 8 and 12-in. submarine, laid by Thacher & Breymann, Toledo, and 8-in. laid in boxing supported on piles of N. 4th St. bridge. Boxing for latter was double, with air-space between pipe and inner box packed with lamp-black, a non-absorbent and non-conductor. Connection with underground pipes made in brick wells, to prevent freezing at junction.

Distribution.—*Mains*, 16 to 6-in. c. i., 13 miles. *Services*, galv. i. Pipe from Addyston (O.) Pipe & Steel Co., and Donaldson Iron Co., Emaus, Pa.; specials from Builders' Iron Foundry, Providence, R. I.; trenching and pipe-laying sublet to Carroll E. Gray, Jr., Chicago, Ill. *Taps*, 480. *Meters*, 12. *Hydrants*, Coffin, 180. *Valves*, Rensselaer. *Pressure-recording gauge*, Edson.

Consumption, not given. *Pressure:* Ordinary, 40 to 75 lbs. Fire, 125 lbs.

Financial.—(In '87.) Cost, withheld, est., $140,000. Cap. stock, $200,000. Debt and int., withheld. Ann. op. exp., withheld, est., $5,000. Ann. rev., consumers, withheld, est., $12,000; city, $4,200. Hydrant rental, $4,200, for 180, or about $25 each; $25 for each hydrant on extensions, hydrants 400 ft. apart.

Management.—Prest., B. R. Clarke. Treas., A. B. Turner. Both of Boston. Supt., J. C. Howe.

Reference.—For further data and full illustrations, see *Engineering News*, vol. XXII., pp. 50-5.

KENOSHA, *Kenosha Co.* (Pop., 5,039; est., 7,000.) On Lake Michigan, bank of which at this point is from 8 to 15 ft. above water. Ground rises gradually for 3 miles to height of 60 ft. Has various manufactories. Settled in '35; incorp. city in '50.

History.—Built in '78-9 by Park City Water Co., under 20-years franchise. Des. Engr., Chas. O'Connor. Labor done by company.

Water Supply.—Four flowing artesian wells, by gravity. First well 4¼ ins. diam. x 1,365 ft. deep, cased with iron pipe for 185 ft. from surface. Rock was encountered at 90 ft. below surface.

Distribution.—(In '87.) *Mains*, 6 to 3-in. c. i., 4 miles. *Services*, lead; w. i. services were rapidly destroyed by water. *Taps*, 425. *Meters*, 6. *Hydrants*, Morgan, 33. *Valves*, Eddy.

Consumption (in '87), 400,000 galls. *Pressure:* Ordinary, 32 lbs. Fire, 45 lbs.

Financial.—(In '87.) Cost, $25,000. Cap. stock, $12,000. No debt. Ann. op. exp., $1,500. Ann. rev.: consumers, $4,000; city, $825. Hydrant rental, $25.

Management.—Prest., Lewis Bain. Secy. and Supt., E. J. Hazleton. Treas., U. J. Lewis.

KILBOURN CITY, *Columbia Co.* (Pop., 945; est., 1,200.) On Wisconsin river. Summer resort. Incorp. village. No sewers or electric lights.

History.—Built prior to '89, and extensions made in in '89-90 by village. Engr., G. M. Marshall, Supt.

Water Supply.—Surface well near river, pumping to tanks. Water previously pumped from artesian wells to tanks.

Pumping Machinery.—Dy. cap., not given; Smith & Vaile.

Tanks.—Cap., 45,000 galls.; two, of wood; 145 ft. elevation.

Distribution.—*Mains*, 6-in. c. i., 3,500 ft.; from Addyston Pipe & Steel Co., Cincinnati, O. *Taps*, 40. *Meters*, none. *Hydrants*, Eclipse, 7.

Pressure: Ordinary, on street, 30 lbs. Fire, 100 lbs.

Financial.—Cost, $6,000. Bonded debt, $5,000. Int., 7%.

Management.—Village Board. Secy., J. E. Jones. Supt., G. M. Marshall. Latest report, Jan. 26, '90.

LA CROSSE, *La Crosse Co.* (Pop., 14,505; est., 28,000.) On Mississippi river. La Crosse and Black rivers flow through city, emptying into Mississippi. Central part of city on both sides La Crosse is on low land, north of which is plateau 20 ft., and south of which is another 40 ft., above river. Engaged in manufacturing and lumber interests. Laid out in '51; incorp. city in '56. Has sewers and electric lights.

History.—Built in '77 by city after plans by City Engr. H. I. Bliss. Pumping wa done by mill-owners until pumping works were built by city in '80-1.

Water Supply.—Mississippi river, direct pumping.

Intake Pipe.—C. i., 16-in., 600 ft. long; 173 ft. is submerged and has flexible joints. Laid in '80-1.

Pumping Machinery.—Dy. cap., 7,500,000 galls.; two Blake. *Boilers*, two 18-ft. tubular.

Distribution.—*Mains*, c. i., 18½ miles. *Services*, galv. i. *Taps*, 1,220. *Meters*, 4. *Hydrants*, Mathews, 172. *Valves*, Chapman.

Consumption, 2,219,789 galls. *Pressure:* Ordinary, 60 lbs. Fire, 100 lbs.

Financial.—Cost, $186,409. No separate water debt. In '82 it was est. that about $20,000 of money raised by city bonds had been spent on water-works. Ann. op. exp., $11,025. Ann. rev.: consumers, $15,333; misc., $228.

Management.—Board of Public Works. Prest. and Supt., J. E. Parker. Secy., T. S. Vicker.

MADISON, *Dane Co.* (Pop., 10,324; est., 16,000.) Engaged in manufacturing and trade. Incorp. Has sewers and electric lights.

History.—Built in '82 by city. Engr., Chester B. Davis, Chicago, Ill.

Water Supply.—Eight artesian wells, direct pumping, with stand-pipe under construction Nov. 4, '89. Water escaping from relief valve of pumps passes to small storage reservoir. Wells in and about grounds of pumping station, connected with suction-pipe.

Storage Reservoir.—Cap., 200,000 galls.; 40 ft. in diam., 22 ft. deep.; 18-in. brick wall in cem. mortar, sunk on shoe. A ¼-in. space was left in wall, and filled with asphalt, mixed with ¼ its bulk of silicious sand. Wall started on 9-in. wooden foundation, having steel band on outer edge, ⅜x15 ins., braced at each anchor-rod. Extends 2 ft. into blue clay. Two 2x4-in. wooden rings were built into wall about 5 ft. from top. From these ¾-in. anchor rods were built into wall 5 ft. apart, passing through wooden foundation. Well first excavated 8 ft. deep, then wall built and allowed to stand a week. Well sunk remaining distance by means of hydraulic jets and pumping.

Pumping Machinery —Dy. cap., 4,000,000 galls.; two non-condensing Reynolds-Corliss engines driving 1,500,000 and 2,500,000 Knowles pumps. *Boilers:* Jarvis.

Stand-Pipe.—Cap., about 55,000 galls.; steel, 12½ x 64 ft. On stone and brick tower, 16 to 15 ft. external diam., 68 ft. high; walls about 2 ft. thick. Foundation of concrete, 7 ft. thick, 28 ft. in diam. at base, 22 at top. Pipe encased with brick, surmounted with dome 20 to 30 ft. high. Electrical connection cuts out stand-pipe, if desired, from pump-house. Engr., Supt. Nichols. [Above subject to change as work was under construction time of report, Nov. 4, '89.]

Distribution.—(Oct. 1, '88.) *Mains*, c. i., 23 miles. *Services*, lead. Pipes and specials originally from Cincinnati & Newport Iron Co., and for extensions from Dennis Long & Co., Louisville, Ky.; trenching and pipe-laying done by M. Philbin & Co., Chicago. *Takers*, 1,099. *Meters*, 210. Meter system was adopted in '87, and meters are to be placed on all new services, and upon all old services rating above $12.50, and in time upon every service. *Hydrants*, Mathews, 125. *Valves*, Ludlow.

Consumption, 701,050 galls. *Pressure:* Ordinary, 85 lbs. Fire, 160 lbs.

Financial.—(Oct., '88.) Cost, $188,397. Bonded debt, $76,000. Int., 5%. Ann. op. exp., $9,485. Ann. rev.: consumers, $14,017; taxation, $15,585; material sold, $721.

Management.—Five Comrs. Secy., Jno. Corscot. Supt., E. M. Nichols.

MANITOWOC, *Manitowoc Co.* (Pop., 6,367; est., 8,000.) On Lake Michigan, at mouth of Manitowoc river. Engaged in boat-building, trade and manufacturing. Incorp. No sewers or electric lights.

History.—Built in '88 by Moffett, Hodgkins & Clarke, Syracuse, N.Y., under 20-years franchise. Const. Engr., E. G. Ferriss.

Water Supply.—Lake Michigan, through filter galleries, pumping to stand-pipe.

Filter Galleries.—No data.

Pumping Machinery.—Dy. cap., 4,000,000 galls.; two Worthington.

Stand-Pipe.—Cap., 272,000 galls.; steel, 20 x 116 ft.

Distribution.—*Mains*, 15 miles. *Services*, not given. *Taps*, 150. *Hydrants*, kind not given, 132.

Consumption, 1,200,000 galls. *Pressure*, not given.

Financial.—Cost, $200,000. Debt, $165,000. Int., 6%. Ann. op. exp., $2,500. Ann. rev.: consumers, $8,000; city, $6,500.

Management.—Prest., J. L. Hotchkin. Supt., E. O. Green.

MARINETTE, *Marinette Co.* (Pop., 5,412; est., 12,500.) On Green bay, Lake Michigan, at mouth of Menominee river. Manufactures lumber, machinery and paper. Incorp. Has sewers and electric lights.

History.—Built in '88 by American Water-Works and Guarantee Co., Ltd., Pittsburgh, Pa., under 20-years franchise. Known locally as City Water-Works Co.

Water Supply.—Green bay, by direct pumping.

Pumping Machinery.—Dy. cap., 4,000,000 galls.; Deane.

Distribution.—*Mains*, kind not given, 17 miles. *Taps*, 950. *Meters*, 10. *Hydrants*, Ludlow, 150. *Valves*, Ludlow.

Consumption, 450,000 galls. *Pressure*, 40 to 140 lbs.

Financial.—Cost (in '87), est., $155,000. Cap. stock, $200,000. Bonded debt (in '87), $125,000. Int., 6%. Ann. op. exp., withheld, est., $5,000. Ann. rev.: consumers, $12,000; city, $7,000. Hydrant rental, $46 for first 125, $30 thereafter.

Management.—Prest. S. M. Highlands. Secy.. W. S. Kuhn, both of Pittsburgh, Pa. Treas., J. V. Cockburn. Supt., M. Kirkpatrick.

MARSHFIELD, *Wood Co.* (Pop., 1,001; est., 3,300.) Has electric lights.

General Description.—Fire protection system has been established, and consists of 4-in. pipes laid through main streets, and extending through premises of Upham Mfg. Co., which owns pumps and receives a rental from town for fire protection. Supt., J. D. Watties.

MAZO MANIE, *Dane Co.* (Pop., 1,646.) Has manufactories.

History.—Built in '88 by village, for fire protection and street sprinkling. **Water Supply.**—Millpond of Mazo Manie mill by direct pumping. **Pumping Machinery.**—Dy. cap., not given. Gould & Austin rotary, operated by owners of mill. **Distribution.**—*Mains*, 4-in. w. i., 1,200 ft. *Taps*, 2. *Hydrants*, 4. **Financial.**—Cost, $1,200. No debt. Ann., op. exp., $25. No rev. **Management.**—Supt., S. E. Bronson.

MENOMINEE, *Dunn Co.* (Pop,, 2,589; est., 7,000.) On Red Cedar river. Incorp. No sewers. Has electric lights.

History.—Built in '84-5 by Moffett, Hodgkins & Clarke, Syracuse, N. Y., under 20-years franchise, with E. G Ferriss as Res. Engr.

Water Supply.—Springs and Red Cedar river, pumping to stand-pipe and direct.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; two Gordon & Maxwell dup., comp., cond. *Boilers:* 5 x 16 ft.

Stand-Pipe.—Cap., 88,000 galls.; 15 x 80 ft. Contrs., Riter & Conley, Pittsburgh, Pa.

Distribution.—*Mains*, c. i., 10.6 miles. *Services*, galv. i. Pipe and specials from Shickle, Harrison & Howard Iron Co., St. Louis, Mo.; trenching and pipe-laying done by C. E. Gray, Jr., Chicago, Ill. *Taps*, 190. *Meters*, none. *Hydrants*, Pattee & Draper, 106.

Consumption, 75,858 galls. *Pressure:* Ordinary, 93 lbs. Fire, 150 lbs.

Financial.—Cost, $125,000. Debt, $90,000. Int., 6%. Ann, op. exp., $2,400. Ann. rev.: consumers, $5,000; city, $5,336. Hydrant rental, $50.

Management.—Prest., Jno. F. Moffett. Supt., E. H. Weber.

MERRILL, *Lincoln Co.* (Pop., est., 6,000.) On Wisconsin river. Manufactures lumber. Has electric lights.

History.—Built in '87 by City Water-Works Co., and managed by American Water-Works & Guarantee Co., Ltd., Pittsburgh, Pa.; 30-years franchise.

Water Supply.—Prairie river, direct pumping.

Pumping Machinery.—Dy. cap., 4,000,000 galls.; two Deane.

Distribution.—*Mains*, 12 to 5-in. iron (in '87), 9½ miles. *Services*, not given. Pipe and specials from National Tube Worke, Chicago, Ill. *Taps*, 200. *Meters*, none. *Hydrants*, Ludlow (in '87), 101. *Valves*, Ludlow.

Consumption, 150,000 galls. *Pressure*, not given.

Financial.—Cost (in '87), $98,000. Cap. stock, $125,000. Bonded debt, $80,000. Int., 6%. Ann. op. exp., withheld, est., $3,000. Ann. rev.: total, withheld, est., $10,000. Hydrant rental, $45,

Management.—Prest., S. M. Highlands. Secy. and Treas., W. S. Kuhn. Both of Pittsburgh, Pa. Supt., E. A. Scriver.

MILWAUKEE, *Milwaukee Co.* (Pop., 115,587; est., 185,000.) On Milwaukee bay and river, on Lake Michigan. Two small rivers join Milwaukee about a mile from its mouth. Banks of lakes and rivers rise quite abruptly in some places, and

in gentle slopes in others, to an elevation of 150 ft. on west, and 75 ft. on east of river. City has area of about 17 sq. m., and about 200 miles of streets. Founded in '35. Has sewers and electric lights.

History.—Built in '72-3 by city when pop. was about 75,000. Engr., Moses Lane. Temporary supply was used for about year, having been discontinued in '74.

Water Supply.—Lake Michigan, pumping to stand-pipe and reservoir, with repumping to stand-pipe for high service.

Intake-Crib.—At ordinary low water, depth of lake at crib is 18 ft. Crib is hexagonal, length of outer side being 21 ft., and of inner, 8 ft. Each wall is formed by two rows of piles driven close, with 6 ft. of space between walls filled with stone. Top of crib is 7 ft. above lake surface, and piles are decked with heavy timber. Gates in crib allow water to be drawn at any point from 4 to 12 ft. below surface. Openings are protected by copper wire screens.

Intake-Pipe.—First pipe was of 36-in. c. i., with ball and socket joints. It extends 2,100 ft. into lake, 2½ miles from mouth of river. Piles are are driven each side of pipe, and deck, forming bridge from shore to crib. In '89 new intake was projected, to extend 1½ miles into lake to 45 ft. of water.

Pump Well.—Is 10 ft. wide x 28 ft. long, divided by cross walls. Bottom of well is 20 ins. of masonry laid upon 4-in. oak plank spiked to 12-in. oak timbers; walls are 5 ft. thick. Well bottom is 11 ft. below extreme low, and 16 ft. below extreme high water.

Pumping Machinery.—Dy. cap., 30,000,000 galls.; Allis. In '87 new high service pumping station was established to supersede one erected in '78, and 6,000,000 Allis put in. An old 3,000,000 pump was transferred from old high service station, and will be used as auxiliary. First two pumps at main station have comp., cond. beam engines, coupled to one fly-wheel, arranged to work together or separately; of bucket and plunger pattern, 40-in. diam., of 84-in. stroke, with 28-in. plungers. *Boilers:* return flue and tubular. A 1,000,000 Gordon or Cope & Maxwell, placed in '78.

Force Mains.—*To reservoir:* 36-in. c. i., 525 ft. long. *To stand-pipe:* 30-in. c. i, 5,700 ft. long; formerly crossed Milwaukee river on bridge, placed under river in '89; rigid joints.

Stand-Pipe.—Is 4 ft. in diam. and 130 ft. high, with its top 210 ft. above lake; inclosed in stone masonry tower 24 ft. sq. at base, 175 ft. high. Main shaft, circular, and contains winding stair-case.

River Crossings.—Milwaukee and Menominee rivers crossed by several submerged mains, from 36 to 12 ins. in diam.

Reservoir.—Cap., 21,500,000 galls.; area, 3½ acres; 21 ft. water; 150 ft. above lake; in excavation and embankment. Banks 25 ft. high, without heart-wall, built up in 9-in. layers, rolled; 16 ft. wide on top, with inner slopes of 1½ to 1, outer, 1¾ to 1; inner slopes and bottom covered with 2 ft. of clay puddle, above which is 9-in. layer of broken stone, and upon this a 15-in. stone pavement in cem. Bottom has concrete upon puddle, and outer slopes are sodded. *Discharge-pipes:* 30 in. (provision for two); slope, 1¼ to 1 for short distance. Main laid across reservoir connects influent and effluent pipes, so that city can be supplied directly from stand-pipe. Reservoir leaks occasionally. Built in '72. Engr., see History. Contrs., C. & C. Peterson, Lockport. Cost, $144,374.

Distribution.—*Mains*, c. i., 162½ miles. *Services*, lead. *Taps*, 15,380. *Hydrants*, Mathews, 1,321. *Close of* '80: Mains, 91 miles, Taps, 7,524. Meters, 30. Hydrants, 718. *Valves*, Whittier. *Pressure-recording gauge*, Edson.

Consumption, 19,159,432 galls. *Pressure*, 38 lbs.

Financial.—Cost, $3,136,920. Debt, $1,487,000: $976,000 at 7, $511,000 at 4%. Sinking fund, 5% annually. Ann. op. exp., $102,937. Ann. rev.: consumers, $261,426; city, $10,790, for sprinkling. Cost, close of '80, $2,171,195. Rev.: '80, $112,524. Ordinance providing for an allowance by city of $20 a hydrant has been passed, but it has never been allowed.

Management.—Board of Public Works. Prest. Ex-officio and city Engr., Geo. H. Benzenberg. Secy., Geo. P. Traenmer.

NEILLSVILLE, *Clark Co.* (Pop., 1,050; est., 2,500.) On Black river. Engaged in lumber industries and manufacturing. Incorp. No sewers. Has electric lights.

History.—Built in '85 by village. Since '89 Electric & Water Supply Co. operate works and furnish city with lights, under one contract. City collects water rents.

Water Supply.—Creek, by direct pumping.

Pumping Machinery.—Dy. cap., 500,000 galls.; Worthington. *Boiler:* steel. Additional pumps and boilers were proposed in '89.

Distribution.—*Mains*, c. i., 4½ miles. *Taps*, 15. *Meters*, none. *Hydrants* Holly, 11.

Consumption, 10,000 galls. *Pressure*, 90 lbs.

Financial.—Cost, not given, est., $20,000. Debt, none. Ann. op. exp., not kept separately for water and light, but est. that water costs city $1,200. Ann. rev.: consumers, not given, est., $300.

Management.—Prest., Jno. Paulus. Secy. and Supt., R. F. Kornitz.

OCONTO, *Oconto Co.* (Pop., 4,171; est., 5,000.) On Green bay at the mouth of Oconto river. Engaged in lumber industries and manufacturing. Settled in '55; incorp. city in '68. Has electric lights.

History.—Small works for domestic supply built in '83 by Oconto Water-Works Co. Des. Engr., P. W. Preeze.

Water Supply.—Oconto river, pumping to tank.

Pumping Machinery.—Dy. cap., not given; Deane, 7½ x 10-in. steam, 5-in. water cylinder.

Tank.—Cap., 32,000 galls.; 50 ft. above village.

Distribution.—*Mains*, Wyckoff, 1.4 miles. *Services*, w. l. *Taps*, 20. *Meters*, none. *Hydrants*, Holly, 6.

Pressure, 27 lbs.

Financial.—Cost, $4,000. Cap. stock, 10,000. No debt. Ann. op. exp., small. Ann. rev.: consumers, withheld, est., $500; city none.

Management.—Prest., A. Cole. Secy. and Treas., W. K. Smith. Supt., Chas. Hall.

NOTE.—Complete works were projected in '89 by E. Scofield and Higgins Bros. Est. cost, $250,000.

OSHKOSH, *Winnebago Co.* (Pop., 15,748; est., 25,000.) On Lake Winnebago at mouth of Fox river, on nearly level prairie, ground not rising at any point more than 20 ft. above lake. Has extensive lumber industries. Settled in '43; incorp. city in '55. Has sewers and electric lights.

History.—Built in '84 by Oshkosh Water Co., under 30-years franchise. Des. Engrs., MacRitchie & Nichol, Chicago, Ill. Const. Engrs. and Contrs., Holly Mfg. Co., Lockport, N. Y.

Water Supply.—Lake Winnebago and artesian wells, direct pumping. Supply at first was from 3 wells, 2, 5 and 3 ins. in diam., 500, 300 and 150 ft. deep, respectively. These discharged into receiving reservoir, water being found at rock, 105 ft. below surface.

Reservoir.—Is 75 x 150 ft., x 17 ft. deep, and 4 ft. above lake level; excavated in clay, paved with dry stone.

Pumping Machinery.—Dy. cap., 8,000,000 galls.; two 4,000,000 Gaskill, horizontal comp., dup..

Distribution.—*Mains*, c. i., 24 miles. *Services*, lead. *Taps*, 750. *Meters*, 30. *Hydrants*, Holly, 240. *Valves*, Ludlow.

Consumption, 1,200,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 115 lbs.

Financial.—Cost (in '87), $300,000. Cap. stock (in '88), $200,000. Bonded debt (in '88), $260,000. Int., 6%. Ann. op. exp., $7,500. Ann. rev.: consumers, $10,000; city, $16,340. Hydrant rental, $70 each for 200, and $60 for additional.

Management.—Prest., D. L. L. Libbey. Secy., G. W. Burnell. Treas., G. W. Roe. Supt., F. B. Barnes.

PORTAGE, *Columbia Co.* (Pop., 4,346; est., 6,000.) Engaged in manufacturing and trade. Incorp. No sewers. Has electric lights.

History.—Built in '87 by Portage City Water Co., controlled by Moffett, Hodgkins & Clarke, Syracuse, N. Y., under 20-years franchise. Labor on masonry, trenching and pipe-laying done by day, under Co.'s engineer, E. G. Ferriss.

Water Supply.—Wisconsin river, filtered, pumping to stand-pipe and direct. Supply taken 1½ miles above city.

Intake and Filter.—Water brought to pump through double wooden flume, first passing for 50 ft. through filter of broken stone and gravel. Each division of flume has gate, and contains sponge filter. A 14-in. intake pipe runs out into stream from bottom of filter. To prevent obstruction by sand intake pipe is placed on oak piles only 2 ins. thick, driven edgewise to current, so that water sweeps under bottom of pipe. Outer end of pipe is turned down stream, and blow-off from the force main is connected with intake, so stand-pipe can be discharged through latter.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two Worthington.

Force Mains.—Are 14 and 10 ins. in diam., leading to stand-pipe.

Stand-Pipe.—Cap., 76,000 galls., 25 x 80 ft.; at elevation of 70 ft., top being 150 ft. above town; of steel plates, 9-16 to ⅛ in. thick. Contrs., Riter & Conley, Pittsburgh, Pa.

Distribution.—*Mains*, c. i., 9 miles. *Services*, galv. i. Pipe and specials from Warren Foundry & Machine Co., Phillipsburgh, N. J., and Lake Shore Foundry, Cleveland, O. *Taps*, 181. *Meters*, 8. *Hydrants*, Ludlow, 75. *Valves*, Ludlow.

Consumption, 140,000 galls. *Pressure*, not given.

Financial.—Cost, $125,000. Bonded debt, $100,000. Int., 6%. Ann. op. exp., $2,500. Ann. rev.: consumers, $6,000; city, $3,000. Hydrant rental, $3,000, or $40 each.

Management.—Prest., E. G. Ferriss. Supt., Jas. W. Reade.

PRAIRIE DU CHIEN, *Crawford Co.* (Pop. 2,777; est., 3,400.) On Mississippi river, on slightly rolling prairie about one mile wide, extending back to high bluffs. Has manufactories. Settled in 1776; incorp. city in '78. No sewers or electric lights.

History.—Built in '75-6 by Prairie du Chien Artesian Water Co. Des. Engr., Ira P. Brunson.

Water Supply.—Flowing artesian well, by gravity. Well is 6 ins. in diam., 975 ft. deep; first 150 ft. is through sand and was cased with iron; this rusted out and was replaced with copper; rest of well is through rock. Water is strongly mineral and saline and is but little used for domestic purposes. It discharges at surface with head equal to 50 ft.

Distribution.—*Mains*, c. i. ¾-mile. *Services*, lead. *Taps*, 12. *Meters*, none. *Hydrants*, Ludlow.

Consumption, unknown. *Pressure*, about 25 lbs.

Financial.—Cost, $10,000. Cap. stock, $4,200. No debt. Ann. op. exp., $100. Ann rev.: consumers, $200; city, $210. Hydrant rental, $30.

Management.—Prest., M. Menges. Secy. and Supt., Wm. Newton.

RACINE, *Racine Co.* (Pop., 16,031; est., 23,000.) On Lake Michigan, at the mouth of Root river, on a plateau about 40 ft. above lake. Has extensive manufactories and lake commerce. Settled in '35; incorp. city in '48. Has electric lights.

SUPPLY PRIOR TO '87.

General Description.—About '70 Artesian Well Co. sunk a well 1,300 ft. deep, from which water was furnished to one ward. In '78 city bored a well. The yield of each well in '81 was about 550,000 galls., and at that time there were 200 taps and 4 hydrants. It is not stated whether the Artesian Well Co. is still in existence.

THE RACINE WATER CO.'S WORK.

History.—Built in '86-7 under a 25-years franchise. Des. Engr., A. H. Howland. Const. Engr., Geo. A. Ellis. Contrs., Wisconsin Const. Co. All of Boston, Mass.

Water Supply.—Lake Michigan, pumping to stand-pipe.

Intake Pipe.—C. i., 24-in., about 1½ miles long, extending 1¼ miles into lake to 40 ft. of water; has bell and spigot joints, and was usually lowered to place in sections of 6 lengths, or 72 ft. These were put together on a dock, towed by scows to place where they were to be sunk, and lowered to place. Sections were buoyed up by casks. Pipe was laid in a trench dredged 10 ft. below bed of lake. Contrs.: Thacher & Breymann, Toledo, O.

Pump-Well.—Is 14 ft. in diam., carried 14¾ ft. below lowest water, with a 2-ft. concrete floor. A wall with screens divides the well into two equal parts. Intake and suction pipes are within 2 ft. of floor, supported on iron frame-work. A system of valves provides for drawing water directly from the intake pipe, and not through well, also for turning 200 ft. head from stand-pipe into intake to free it from anchor ice or other obstructions.

Pumping Machinery.—Dy. cap., 4,500,000 galls.; 1,000,000 Worthington, also Blake; two dup., one a comp., other high pressure. *Boilers:* a battery of four 6x16-ft. boilers.

River Crossings.—Three, of 24, 20 and 8-in. c. i. pipe; first two are in a trench, 22, third in one 18 ft. below river's surface. Laid by Thacher & Breymann, as described for intake.

Stand-Pipe.—Cap., 330,000 galls.; 25x100 ft., on beton foundation and pedestal carried 55 ft. above original ground surface, or 110 ft. above lake datum. Foundation carried 7 ft. below original ground surface, where it is 37 ft. in diam. Pedestal is 26½ ft. in diam., and consists of an outer solid ring, 4 ft. thick, a hollow space for

4 ft., then a solid 10 ft. in diam. At 19, 37 and 55 ft. above ground external ring is connected with the central shaft by semicircular arches and floors. The material used in construction was one part Saylor's American Portland cem., and one of lake beach sand and gravel. Foundation and pedestal are on tenacious, clayey hardpan, which sustains est. pressure of 3.3 tons per sq. ft. In the hollow ring in the pedestal is a 10-in. inflow and 16-in. outflow pipe. Each pipe contains a valve, that in the 10-in. pipe being arranged for operation from the pumping station. Contrs. for pipe, itself, Tippett & Wood, Phillipsburgh, N. J.

Distribution.—(About middle of '88.) *Mains*, c. i., 32 miles. *Services*, galv. i *Taps*, withheld, est., 1,300. *Meters*, not given. *Hydrants*, Coffin, 314. *Pressure-recording gauge*, Edson.

Consumption, not determined. *Pressure:* Ordinary, 65 lbs. Fire, 125 lbs.

Financial.—Cost, $750,000. Bonded debt, $400,000. Ann. op. exp., withheld, est., $12,000. Ann. rev.: consumers, withheld, est., $35,000; city, about $14,000. Hydrant rental, $45 each for first 300, $25 for additional.

Management.—Prest., Henry E. Cobb. Treas., C. E. Eddy. Both of Boston, Mass. Secy., J. E. Dodge. Supt., W. H. Laing.

RICHLAND CENTRE, *Richland Co.* (Pop., 1,227; est., 1,350.) On Pine river. Has lumber industries. No electric lights.

History.—Built in '89 by city; put in operation Nov. 1.

Water Supply.—Artesian well, pumping to reservoir.

Pumping Machinery.—No data.

Reservoir.—Cap., about 600,000 galls. Contrs., Rockford Construction Co.

Distribution.—*Mains*, 8 to 4-in., about 4 miles. *Taps*, 75.

Financial.—Cost, $20,000. Debt, $20,000. Int., 5%.

Management.—No data. Report by K. W. Eastland; date, Oct. 30, '89.

RHINELANDER, *Oneida Co.* (Pop., est., 2,500.) On Wisconsin river, which furnishes water-power. Engaged in manufacturing and lumbering. Not incorp. No sewers or electric lights.

History.—Built in '87 by town, by days labor. Originally for fire protection, but now supplies water for domestic purposes.

Water Supply.—Wisconsin river, direct pumping.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Smedley dup., high-pressure.

Distribution.—*Mains*, 8 and 6-in., 1½ miles. *Taps*, 20. *Meters*, none. *Hydrants*, 12.

Consumption, 1,000 galls. *Pressure*, not given.

Financial.—Cost, $12,000. Debt, none. Ann. op. exp., $2,000. Ann. rev.: consumers, $400.

Management.—Water Board. Chn., W. E. Brown. Clerk, W. W. Low. Supt., Jno. Doherty.

RIPON, *Fond du Lac Co.* (Pop., 3,117; est., 4,000.) Has water-power and manufactories. Incorp. No sewers or electric lights.

History.—Pipe was being received about Mar. 1, '90, and construction was to be started as soon as frost was out of ground, by Ripon Water-Works Co.; to be in operation about July, '90. Des. Engr., W. F. Goodhue, Milwaukee.

Water Supply.—Filter gallery holding 80,000 galls., pumping to stand-pipe and direct in case of fire.

Pumping Machinery.—Dy. cap., 1,500,000 galls.

Stand-Pipe.—Cap., 132,000 galls.; 15 x 100 ft.

Distribution.—*Mains*, 12 to 6-in. c. i., 6½ miles. *Hydrants*, Ludlow, 75.

Financial.—Hydrant rental, $4,000 for all, or about $53 each.

Management.—Incorporators: C. E. Gray, J. R. Gray, G. A. Farwell.

NOTE.—Subject to corrections as latest report was made about Mar. 1, '90, before pipe-laying was begun.

SHEBOYGAN, *Sheboygan Co.* (Pop., 7,314; est., 18,000.) On Lake Michigan and Sheboygan river. Engaged in lake commerce, lumber industries and various manufactories. Has electric lights.

History.—Built in '87 by City Water Co., controlled by American Water-Works & Guarantee Co., Ltd., Pittsburgh, Pa. Des. Engr., Benezette Williams, Pullman, Ill.

Water Supply.—Lake Michigan, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 5,000,000 galls.; Worthington.

Distribution.—*Mains*, c. i., 22½ miles. *Services*, galv. i. *Taps*, 475. *Hydrants*, kind not given, 264.

Consumption. 500,000 galls. *Pressure:* Ordinary, 55 lbs. Fire, 90 lbs.

Financial.—(About middle of '88.) Cost, $230,000. Cap. stock, $250,000. Bonded debt, $200,000. Int., 6%. Ann. op. exp., withheld, est., $7,500. Ann. rev.: total, est., $22,500.

Management.—Prest., and Supt., W. D. Cockburn. Secy., W. S. Kuhn, Pittsburgh, Pa. Treas., S. M. Highlands, Pittsburgh, Pa.

SOUTH SUPERIOR, *Douglas Co.* See Superior.

STEVENS' POINT, *Portage Co.* (Pop., 4,449; est., 10,000.) On Wisconsin river. Has manufactories. Incorp. No sewers. Has electric lights.

History.—Built in '87-8 by Stevens' Point Water Co. Engr., Jno. Holmes. Contr., Saml. R. Bullock. Both of N. Y. City.

Water Supply.—Wisconsin river, filtered, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 4,000,000 galls.; two Gaskill dup., comp. cond.

Filter.—Dy. cap., 650,000 galls.; Hyatt; erected July, '89.

Stand-Pipe.—Cap., 228,000 galls.; 20 x 120 ft. Contrs., Tippett & Wood, Phillipsburgh, N. J.

Distribution.—*Mains*, c. i., 10½ miles. *Services*, w. i., lead. *Taps*, withheld, est., 400. Pipe and specials from Florence Iron Works, Philadelphia, Pa. *Hydrants*, Holyoke, 110.

Financial.—Cost, withheld, est., $150,000. Cap. stock, $175,000. Bonds, $175,000. Int., 6%. Ann. op. exp., withheld, est., $4,000. Ann. rev.: consumers, withheld, est., $8,000; city, $5,000. Hydrant rental, $35.

Management.—Prest., Wm. Yorke at Lee. Secy. and Treas., W. G. Snow. Both of 2 Wall St., N. Y. City. Supt., W. O. Lamoreux.

STOUGHTON, *Dane Co.* (Pop., 1,353; est., 3,500.) On Catfish river. Manufactures plows and wagons. No sewers. Electric lights projected in '89.

History.—Built in '85 by village. Engr. and Contr., Geo. C. Morgan, Chicago, Ill.

Water Supply.—Surface well, pumping to tank.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; two Deane, one comp., and one high pressure.

Tank.—Cap., 30,000 galls.; on Morgan's special tower, at elevation of 116 ft.

Distribution.—*Mains*, 10 to 4-in., c. i. 3¾ miles. *Services*, not given. *Taps*, 110. *Meters*, i. *Hydrants*, kind not given, 34.

Consumption, 40,000 galls. *Pressure*, not given.

Financial.—Cost, $30,000. Bonded debt, $30,000. Ann. op. exp., $1,200. Ann. rev.: consumers, $1,000.

Management.—Supt., C. B. Davis.

SUPERIOR and WEST SUPERIOR, *Douglas Co.* (Pop.: Superior, 655; est., 3,000. West Superior, est., 3,000.) At west extremity of Lake Superior, incorp. city, and has sewers and electric lights.

History.—Built by Superior Water-works Co. in '87-8. Also supplies So. Superior. Contrs., R. B. C. Bement & Co., St. Paul, Minn.

Water Supply.—Superior bay, by direct pumping.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; kind not given; comp., dup.

Distribution.—*Mains*, 16 to 4-in. c. i., 10 miles. *Services*, lead. *Taps* (in '87), 53. *Meters*, 4. *Hydrants*, Mathews, 106. *Valves*, Eddy.

Consumption, 150,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 100 lbs.

Financial.—Cost, $200,000. Cap. stock, $100,000. Bonds, $200,000. Annual op. exp., withheld, est., $3,500. Ann. rev.: total, withheld, est., $20,000. Hydrant rental, $75 each for first 100, $60 for second 100, $50 for each additional.

Management.—Prest., R. J. Wemyss. Secy., F. W. Downes. Treas., W. D. Vernam. Supt., Wm. Bennett. Offices at W. Superior.

WASHBURN, *Bayfield Co.* (Pop., est., 4,000.) On Lake Superior. Has lumber industries. Not incorp. No sewers or electric lights.

History.—Built in '89 by Washburn Water-Works Co.; put in operation about Oct. 15. Engrs. and Contrs., Moffett, Hodgkins & Clarke, Syracuse, N. Y. Supt. of Const., R. C. Pearsons.

Water Supply.—Chequamegon bay, Lake Superior; pumping to reservoir, and direct.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; Deane; a comp. and a comp., dup. *Boilers:* from Wilkes Bros., E. Saginaw, Mich.

Reservoir.—Cap., 1,000,000 galls.

Distribution.—*Mains*, 10 to 6-in. c. i., 4 miles; from Jackson & Woodin Mfg. Co. Berwick, Pa. *Services*, galv. i. *Hydrants*, Chapman, 50. *Valves*, Scott.

Pressure: Fire, 85 lbs.

Financial.—Cost, est., $78,000. Cap., stock, authorized, $100,000. Bonded debt $75,000. Int., 6%.

Management.—Prest., W. G. Maxcy. Secy., C. C. Clausen. Treas., D. M. Maxcy. Principal report, Sept. 30, '89.

WAUKESHA, *Waukesha Co.* (Pop., 4,613; est., 6,000.) On Fox river, which furnishes water-power. Summer resort. Incorp. village. Sewers projected. Has electric lights.

History.—Built in '87 or '88 by Waukesha Water-Works Co.

Water Supply.—Two surface wells, also artesian well; pumping to stand-pipe and direct; one well is 40 ft. diam., 26 ft. deep, other 55 ft. diam., 26 ft. deep, sunk into water-bearing gravel. Artesian well is 1,500 ft. deep, ending in Potsdam sandstone.

Pumping Machinery.—Dy. cap., 4,000,000 galls.; Knowles. *Boilers:* two horizontal, one upright.

Stand-Pipe.—Cap., 330,000 galls.; 40 x 35 ft.; on hill 185 ft. above village.

Distribution.—*Mains*, w. i., 10 miles. *Services*, not given. *Taps*, 225. *Meters*, none. *Hydrants*, Chapman, 92.

Consumption, 100,000 galls. *Pressure*, not given.

Financial.—Cost, $100,000. Debt, $60,000. Int., 6%. Sinking fund, 10% of gross receipts. Ann. op. exp., $2,500. Ann. rev.: total, withheld, est., $9,000. Hydrant rental, $37.50.

Management.—Prest., E. Marvin. Secy., T. M. Halghy. Treas., A. J. Frame Supt., Geo. F. Deakin.

WAUSAU, *Marathon Co.* (Pop., 4,277; est., 8,500.) On Wisconsin river. Engaged in manufacturing, mining and granite quarrying. Incorp. No sewers. Has electric lights.

History.—Built in '85 by city. Engr., W. R. Coats, Kalamazoo, Mich. Contrs., Holly Mfg. Co., Lockport, N. Y.

Water Supply.—Well, by direct pumping. Suction pipe connects with Wisconsin river for use in emergency. Well is 30 ft. from pumping station, 40 ft. diam., 37 ft. deep to bottom of shoe upon which caisson is constructed. Bottom of suction pipe is about 3½ ft. from bottom of well, 27 ft. below pumps and 10 ft. below water surface.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; Gaskill horizontal, comp. *Boilers:* two, 5 x 16 ft.

Distribution.—(Nov. 30, '88.) *Mains*, c. i., 11½ miles. *Services*, lead. *Taps*, 502. *Meters*, none. *Hydrants*, Holly-Gaskill, 111. *Pressure-recording gauge*, Edson.

Consumption, 438,249 galls. *Pressure*, 45 lbs.

Financial.—Cost, $132,126. Bonded debt, $90,000. Int., 5%. Sinking fund, $4,500. Ann. op. exp., $4,852. Ann. rev.: consumers, $6,377; misc., $103.

Management.—Three Comrs. Prest., J. M. Smith. Secy., Jno. Ringle. Supt. P. Ringle.

WEST DE PERE, *Brown Co.* (Pop., 1,870; est., 2,088.)

History.—Built in '87-8 by West De Pere Artesian Water Supply Co., under 25-years franchise. Engrs. and Contrs., A. L. Holmes, Grand Rapids, Mich., Mich. Pipe Co., Bay City. Unofficially reported in '89 that city would probably buy the works.

Water Supply.—Artesian well, by gravity, there being natural pressure of 43 lbs. Contrs. for well, Gray Bros., Milwaukee, Wis.

Distribution.—(In '87.) *Mains*, Wyckoff wood, 3 miles; furnished and laid by Michigan Pipe Co., Bay City. *Services*, galv. i. *Taps*, about 100.

Consumption, not given. *Pressure*, about 40 lbs.

Financial.—(In '87.) Cap. stock, $20,000. No bonds. Debt, $2,200, without int. Ann op. exp. and rev., not determined. Hydrant rental, $20 and $25.

Management.—(In '88.) Prest., W. A. Bringham. Supt., J. P. Willard. Report by A. Wilcox.

NOTE.—No report for '89 could be obtained.

WEST SUPERIOR, *Douglas Co.* See Superior.

WHITEWATER, *Walworth Co.* (Pop., 3,617; est., 6,000.) Incorp. city. No sewers. Has electric lights.

History.—Built in '89 by Whitewater Water-Works Co., under 25-years franchise; put in operation Oct. 1. Des. Engr., Jno. A. Cole, Chicago, Ill. Const. Engrs. and Contrs., C. E. Gray, Jr. & Co., Chicago, Ill.

Water Supply.—Artesian well, pumping direct to tank and reservoir. Well had dy. yield in '89 of 500,000 galls., 20-ft. head.

Pumping Machinery.—Dy. cap., 300,000 galls.; Deane. *Boilers:* from Frost Mfg. Co., Galesburgh, Ill.

Tank.—Cap., 160,000 galls.; 30 ft. high, on 80-ft. tower; from Mansfield (O. Machine Works.

Reservoir.—Cap., 750.000 galls.

Distribution.—*Mains*, 16 to 4-in. c. i., 9 miles; from Lake Shore Foundry Co., Cleveland. *Hydrants*, Ludlow, 96. *Valves*, Ludlow.

Pressure: Ordinary, 60 lbs. Fire, 125 lbs.

Financial.—Cost, $90,000. Cap. stock, $80,000. Bonded debt, $72,500. Int., 6%. Ann. op. exp., est., $2,000. Ann rev.: consumers, est., $4,500; city, $4,000. Hydrant rental, about $41.

Management.—Prest., C. E. Gray, Waukesha. Secy., J. R. Gray, Waukesha. Treas., C. E. Gray, Jr., Chicago, Ill. Supt., T. W. Gray. Report, Sept. 19, '89.

Water-Works Projected with Fair Prospects of Construction.

ANTICO, *Langlade Co.* (Pop., est., 4,500.) Has manufactories and electric lights.

Proposed Works.—Sept. 7, '89, J. F. Doyle, Mayor, stated that special election on water-works question would be held Sept. 17. City Council had recommended granting franchise to some Co., giving yearly rental of $75 each for 50 hydrants. Supply, wells, pumping to reservoir. No later data can be obtained.

DELAVAN, *Walworth Co.* (Pop., est., 1,800.)

Proposed Works.—Jan. 20, '90, bids were received by village for franchise. Pumping to stand-pipe. Est. cost, $20,000. Results not reported. Prest. Com., F. L. von Suessmilch.

RICE LAKE, *Barron Co.* (Pop., 454; est., 2,500.) Has lumber industries.

Proposed Works.—Rice Lake Lumber Co. to build for their own use, and there is talk of supplying city from same plant. City Clerk, Sewell A. Peterson. Report, about Dec. 1, '89.

Water-Works Projects Reported in '89 and '90, but Now Indefinite.

Brodhead, Green Co. *Clinton*, Rock Co. *Wauwatosa*, Milwaukee Co.

Group 6.—NORTHWESTERN STATES.—Water-Works completed, in process of construction or projected, in Iowa, Minnesota, Kansas, Nebraska, Dakota, Wyoming, and Montana.

IOWA.

Water-Works Completed or in Process of Construction.

ANAMOSA, *Jones Co.* (Pop., 2,083; est., 3,200.) On Wapsipinicon river. Incorp. No sewers or electric lights.

History.—Built in '73-4 by Anamosa Water-Works Co. Engr., J. C. Weir.

Water Supply.—Wapsipinicon river pumping to reservoir and direct.

Pumping Machinery.—Dy. cap., 700,000 galls.; 300,000 Gordon & Maxwell steam, erected in '75, and 400,000 water-power.

Reservoir.—Cap., about 90.000 galls.

Distribution.—*Mains*, c. i., 2½ miles. *Services*, w. i. *Taps*, 100. *Meters*, none, *Hydrants*, kind not given, 11.

Consumption, 60,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—Cost, about $23,000. Cap. stock, $12,000. Bonded debt., $9,000. Int., 8%. Ann. op. exp., $1,000. Ann. rev.: consumers, $2,100; city, $1,050. Hydrant rental, five-mill tax is paid on all property within 800 ft. of hydrants.

Management.—Prest., B. Higgins. Secy., W. K. Pearson. Treas., T. W. Shapley. Supt., J. C. Griffith.

ATLANTIC, *Cass Co.* (Pop., 3,602; est., 5,000.) On Troublesome creek, on rolling prairie. Settled in '69; incorp. city of second class in '77. No sewers or electric lights.

History.—Built in '82-3 by Atlantic City Water Co., under 25-years franchise; leased and operated by city. Des. Engr., T. Cowell. Contrs., Denison & Cowell, Muscatine, Ia.

Water Supply.—Cook system of wells, direct pumping. Water was first taken from impounding reservoir on creek, and was filtered. Six additional wells constructed in '89.

Pumping Machinery.—Dy. cap., 2,500,000 galls.; 1,500,000 and 1,000,000 Holly quadruplex.

Distribution.—*Mains*, c. i., 6 miles. *Services*, w. i. *Taps*, 403. *Meters*, none in use. *Hydrants*, Holly, 72.

Consumption, 250,000 galls. *Pressure:* Ordinary, 75 lbs. Fire, 120 to 130 lbs.

Financial.—Cost, $75,000. Cap. stock, $21,000. Bonded debt, $50,000. Int., 6%. Ann. op. exp., $7,374. Ann. rev.: consumers, $3,824; city, $3,718. Hydrant rental, $60.

Management.—Secy. and Supt., W. A. Wilken. Treas., H. J. Cavenaugh.

AUDUBON, *Audubon Co.* (Pop., 792; est., 1,800.) On Blue Grass creek on rolling prairie. Settled in '78; incorp. city in '80. No sewers or electric lights.

History.—Built in '83 by city. Engr., Wm. H. Burnham.

Water Supply.—Well, 16 ft. in diam., pumping to tank.

Pumping Machinery.—Dy. cap., 100,000 galls.; Smith & Vaile double-acting, 5 x 10-in.; formerly driven by steam.

Tank.—Cap. 106,000 galls.; 30 x 20 ft.; on a timber trestle 24 ft. high; 90 ft. above pump, 65 ft. above business part of town.

Distribution.—*Mains*, c. i., 2,500 ft. *Services*, w. i. *Taps*, 30. *Meters*, none. *Hydrants*, Holly, 7.

Consumption, 20,000 galls. *Pressure:* Ordinary, 65 lbs. Fire, 90 lbs.

Financial.—Cost, $9,000 Debt, $5,500. Int., 4½%. Sinking fund, 2-mill tax, annually. Ann. op. exp. (in '87), $40. Ann. rev.: consumers, about $300.

Management.—Secy., J. A. Wheatley. Treas. and Supt., E. J. Freeman.

BOONE, *Boone Co.* (Pop., 3,330; est., 7,000.) On elevated rolling prairie, two miles west of Des Moines river. Engaged in mining and manufacturing. Settled in '61; incorp city in '65. Has sewers and electric lights.

History.—Built in '84 by city. Des. Engr., T. N. Boutelle. Const. Engr. and Contr., Geo. C. Morgan, Chicago, Ill.

Water Supply.—Artesian well, pumping to tank and direct. In '89-90 another well was in progress.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Deane. *Boilers:* Ferminesch and tubular boilers, 50-H. P. each.

Tank.—Cap., 22,000 galls.; iron, on brick tower.

Distribution.—(In '87.) *Mains*, c. i., 1.7 miles. *Services*, w. i. *Taps*, 35. *Meters*, 1. *Hydrants*, Morgan, 19.

Consumption, 50,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 120 lbs.

Financial.—Cost, $28,000. Debt, $23,000. Int. 6%. Ann. op. exp. (in '87), $2,500. Ann rev.: consumers, $500.

Management.—Com. Chn. Com., E. C. Culver. Supt. and City Clerk, F. D. Gay.

BURLINGTON, *Des Moines Co.* (Pop., 19,450; est., 30,000.) On Mississippi river, from which ground rises gradually to elevation of 200 ft. above bluff. Settled in '33. Incorp. city. Has sewers and electric lights.

History.—Built in '77-8 by Burlington Water Co., under 25-years franchise. Engr., T. N. Boutelle. Contrs., Holly Mfg. Co., Lockport, N. Y. Sub-contrs.: for inlet pipe and crib, Truman Cowell, Muscatine; filter bed and buildings, A. W. Manning, Burlington.

Water Supply.—Mississippi river filtered, by direct pumping.

Intake Crib and Pipe.—Crib is of pine timbers, planked on sides and bottom; is 250 ft. from shore, in 19 ft. of water, and is connected with filter bed by 235 ft. of 24-in. c. i. pipe. In '89 new intake, about 550 ft. long was projected, old one having become partially filled with sand.

Filter Bed.—Is 20 ft. wide, 120 ft. long, with stone masonry walls; bottom is an inverted arch of 18-in. versed sine. Over this is laid floor of 2 x 4-in. scantling, with ½-in. spaces, and on this 3½ ft. of gravel and sand, graded in size. Water is admitted at bottom and rising through sand and gravel flows to pump-well. Filter has not given entire satisfaction, and water has often been drawn directly from river.

Pumping Machinery.—Dy. cap., 6,500,000 galls.; 3,000,000 Holly quadruplex and 3,500,000 Gaskill horizontal; quadruplex pump has 19 x 27-in. steam, 10-in. water cylinders. In Dec., '79, corn cobs were used for fuel with reported saving of 50% over coal, latter then costing $2.62 a ton.

Distribution.—*Mains*, c. i., 19½ miles. *Services*, w. i. Pipe and specials for original works from Dennis Long & Co., Louisville, Ky., and H. R. Smith & Co., Columbus, O.; trenching and pipe-laying done by Russell & Alexander, Chicago, Ill. *Taps*, 1,542. *Meters*, 90. *Hydrants*, Holly, 215. *Valves*, Eddy.

Consumption, 1,250,000 galls. *Pressure:* Ordinary, 90 lbs. Fire, 150 lbs.

Financial.—Cost (in '87), $200,000. Cap. stock, $300,000. Debt, about $178,000. Int., 6%. Ann. op. ex., withheld, est., $10,000. Ann. rev.: consumers, withheld, est., $30,000; city pays interest on Co.'s bonds, for fire protection.

Management.—Prest., Geo. D. Rand, Keokuk, Ia. Supt., Chas. Hood.

CARROLL, *Carroll Co.* (Pop., 1,385; est., 2,500.) In lumber, sandstone, limestone and coal region. Has electric lights.

History.—Built in '83-4 by town. Engrs. and Contrs., U. S. Wind Engine & Pump Co., Batavia, Ill.

Water Supply.—Surface well, pumping to tank.

Pumping Machinery.—Dy. cap., not given. Pump driven by windmill.

Tank.—Cap., 70,000 galls.

Distribution.—(In '87.) *Mains*, c. i., 0.7 mile. *Services*, iron. *Taps*, 12. *Meters*, none. *Hydrants*, 10.

Financial.—(In '87.) Cost, $10,500. Debt, $10,000. Int., 6%. Ann. op. exp., $100. Ann. rev.: consumers, $125.

Management.—Chf. Fire Dept., Jas. Thompson.

NOTE.—No report for '89 could be obtained.

CEDAR FALLS, *Linn Co.* (Pop., est., 3,500.) On Cedar river, having good water-power used in manufacturing. No sewers. Has electric lights.

History.—Built in '87-8 by town. Engr., Chas. F. Loweth, St. Paul, Minn. Contrs., American Water & Gas Works Const. Co., Dubuque.

Water Supply.—Springs, pumping to tank.

Conduit.—Wooden, 1,100 ft. long, from springs to pump-well; built by town.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Worthington, dup., high-pressure.

Tank.—Cap., 100,000 galls.; 30 x 20 ft.; wood, on 75-ft. iron trestle. Sub-contr., Wm. Lee, St. Paul, Minn.

Distribution.—(May 27, '89.) *Mains*, 10 to 4-in. c. i., 3.7 miles. *Services*, w. i. Pipe and specials from Shickle, Harrison & Howard Iron Co., St. Louis, Mo. *Taps*, 92. *Meters*, Worthington, 2. *Hydrants*, Mathews, number not given.

Consumption, 50,000 galls. *Pressure*, 80 lbs.

Financial.—(May 27, '89.) Cost, $33,100. Bonded debt, about $30,000. Int., 6%. Ann. op. exp., $1,000. Ann. rev.: consumers, $900.

Management.—Secy., Geo. A. Newman. Supt., Chas. Boehmer.

CEDAR RAPIDS, *Linn Co.* (Pop., 10,104; est., 20,000.) On Cedar river, on slightly rolling ground which rises gradually from the river for about ½ mile to elevation of from 25 to 50 ft. Has water-power and quite extensive manufactories. Settled in '39; incorp. city in '56. Has sewers and electric lights.

History.—Built in '75-6 by Cedar Rapids Water Co. Engr., J. T. Cushing.

Water Supply.—Cedar river for fire protection and artesian well for domestic use, by direct pumping. River has drainage area of about 700 sq. m., and was formerly only source of supply. There are three 5-in. wells, two 1,425 ft., and one 2,225 ft. deep.

Pumping Machinery.—Dy. cap., 6,000,000 galls.; 4,000,000 McGowan, 2,000,000 Worthington, high duty.

Distribution.—*Mains*, c. i., 20 miles. *Services*, w. i., lead. *Taps*, 946. *Meters*, 4. *Hydrants*, Cummings. 153. *Valves*, Eddy.

Consumption, 1,000,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 100 lbs.

Financial.—Cost, $250,000. Debt, $85,000. Int., 6 and 8%. Ann. op. exp., withheld, est. $8,000. Ann. rev.: consumers, withheld, est., $25,000; city, $13,000.

Management.—Prest., C. B. Souther. Secy., J. C. Broeksmit. Treas., W. Buchanan. Supt. C. J. Fox.

CHARLES CITY, *Floyd Co.* (Pop., 2,421; est., 3,500.) On Cedar river. Has water-power used in manufacturing. Incorp. No sewers or electric lights.

History.—Built in '87 by town. Des. Engr., A. A. Richardson, Lincoln, Neb, Const. Engr., W. E. Hinsdale, Chicago, representing Eclipse Wind Engine Co., Beloit, Wis., Contrs.

Water Supply.—Spring, impounded, by direct pumping. An emergency supply can be taken from river.

Pumping Machinery.—Dy. cap., 1,250,000 galls.; 1,000,000 and 250,000 Knowles water-power. *Water-wheels:* 80 and 40-in. Flenniken turbine, under 10 ft. head.

Distribution.—*Mains*, 10 to 4-in. c. i., 2 miles. *Taps*, 25. *Meters*, none. *Hydrants*, Galvin, 25. *Valves* and *boxes*, Galvin.

Consumption, unknown. *Pressure:* Ordinary, 50 lbs. Fire, 100 lbs.

Financial.—Cost, $21,000. Debt, $21,000. Int., 5%. Ann. op. exp., $1,250. Ann. rev.: consumers, $515.

Management.—Fire Com. of 3. Treas., S. H. Starr. Supt., J. C. Sterns.

CHEROKEE, *Cherokee Co.* (Pop., 1,523; est., 3,500.) On Little Sioux river. Incorp. city. No sewers or electric lights.

History.—Built in '89 by city; was to be in operation Aug. 15. Engr., W. W. Curtis, St. Paul, Minn. Contr., E. T. Sykes, Minneapolis, Minn.

Water Supply.—Artesian wells, pumping to stand-pipe. Connection will be made with river for fire protection, if necessary.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Smedley.

Stand-Pipe.—Cap., 152,000 galls.; 18x80 ft.; from Tippett & Wood, Phillipsburgh, N. J.

Distribution.—*Mains*, 10 to 4-in. c. i., 2¼ miles; from So. St. Louis (Mo.) Foundry. *Hydrants*, Mathews, 17.

Pressure: Ordinary, 50 to 80 lbs. Fire, 150 lbs.

Financial.—Cost, $25,000. Bonded debt, $20,000. Int., 5%.

Management.—Com.: J. P. Rankins, J. C. Hall, O. Gage.

NOTE.—Subject to corrections, as latest report was made June 26, '89, just after letting contracts.

CLARINDA, *Page Co.* (Pop., 2,011; est., 4,000.) On Nodaway river. Has manufactories. No sewers or electric lights.

History.—Built in '86, put in operation Jan. 1, '87, by town. Engr., A. A. Richardson, Lincoln, Neb.

Water Supply.—Driven wells, direct pumping.

Pumping Machinery.—Dy. cap., 2,250 galls.; Worthington.

Distribution.—*Mains*, c. i., 5 miles. *Services*, lead. *Taps*, 125. *Meters*, Crown 7. *Hydrants*, Galvin, 36.

Consumption, 100,000 galls. *Pressure:* Ordinary, 65 lbs. Fire, 100 lbs.

Financial.—Cost, $42,500. Bonded debt, $35,000. Int., 5%. Ann. op. exp., $1,980. Ann. rev.: consumers, $1,100.

Management.—Com. of 3. Pumpg. Engr., Jno. M. Stonebaker.

CLINTON, *Clinton Co.* (Pop., 9,052; est., 16,040.) On Mississippi river. Engaged in lumber and other manufacturing. Settled in '55; incorp. in '57. Has sewers and electric lights.

History.—Built in '74-5 by Clinton Water-Works Co., when pop. was about 7,500. Franchise runs till '94. Engr., Wm. C. Weir, deceased. Contrs., Denison & Cowell Muscatine, Ia.

Water Supply.—Two flowing artesian wells, pumping to tank, and direct in case of fire. Wells are 5½ ins. diam. x 1,100 ft. deep, have pressure of 33 lbs. at surface, and discharge into receiving reservoir.

Water was formerly taken from Mississippi river, passing from intake pipe through filter to pumps.

Old Filter.—In two compartments; consisted of sand and gravel in boxes, which could be lowered and raised for cleaning.

Reservoir.—Cap., about 300,000 galls.; 80 ft. sq., 10 ft. deep.

Pumping Machinery.—Dy. cap., 6,000,000 galls.; Gordon & Maxwell, one comp., and one comp., cond., dup.; 2,000,000 erected in '74, 4,000,000 in '88.

Tank.—Cap., 25,000 galls.; iron on tower 100 ft. high.

Distribution.—*Mains*, c. i., 12 miles. *Services*, galv. i. Pipe and specials from Dennis Long & Co., Louisville, Ky. *Taps*, 720. *Meters*, 84. *Hydrants*, kind not given, 150.

Consumption, 1,000,000 galls. *Pressure:* Ordinary, 50 lbs. Fire, 90 lbs.

Financial.—(In '87.) Cost, $120,000. Cap. stock, $200,000. Bonded debt, $70,000. Ann. op. exp. (in '86), $5,000. Ann. rev.: consumers (in '86), $15,000; city, $7,400. Hydrant rental, $50.

Management.—Prest., J. F. Cockburn. Secy. and Supt., W. W. Cunningham. Treas., J. H. Purdy.

COLFAX, *Jasper Co.* (Pop., 620; est., 1,000.) On Chicaqua river, in coal region. Has medicinal springs. Incorp. No sewers or electric lights.

History.—Built in '87 by town, under direction of Council, without contractors, except for trenching. Intended, at first, for fire protection only; but water proving potable, is now used for domestic purposes.

Water Supply.—Three driven wells, pumping to reservoir. Wells are 3 ins. in diam., have 5-in. points, and are driven 19 ft. in gravel.

Pumping Machinery.—Dy. cap., 864,000 galls.; No. 7 Cameron, with 10 x 15-in. steam, 5-in. water cylinders. *Boiler:* 50-H. P.

Reservoir.—Cap., about 70,000 galls.; 24 ft. diam. x 20 ft. deep. 2,840 ft. from, 140 ft. above, pump. Lined with stone wall in Portland cem., 24 ins. thick at bottom, 15 at top. *Discharge-pipe*: 6-in. No leaks. Const. Engr., M. D. Morrison. Des. Engr. and Contr., see History. Cost, $1,400.

Distribution.—*Mains*, 6 and 4-in. c. i., 1¼ miles. *Services*, 1 and ¾-in. w. i. Pipe and specials from Dennis Long & Co., Louisville, Ky.; trenching done by P. H. Cross, Colfax. *Taps*, 65. *Meters*, none. *Hydrants*, Ludlow, 9. *Valves*, Ludlow.

Consumption, 30,000 galls. *Pressure*, 60 lbs.

Financial.—Cost, $7,000. Bonded debt, $6,000. Int., 6%. Sinking fund, $560; raised by 5-mill tax, annually. Ann. op. exp. $250. Ann. rev.: consumers, $450.

Management.—Council. Mayor, J. A. Mattern. Supt., G. A. Goodrich.

COUNCIL BLUFFS, *Pottawattomie Co.* (Pop., 18,063; est., 35,000.) On Missouri river at mouth of Indian creek, opposite Omaha, Neb.; on plain at foot of high bluffs, and on bluffs, which are intersected with ravines. Incorp. Has sewers and electric lights.

History.—Built in '82-3 by Council Bluffs City Water-Works Co., under 20-years franchise. Des. Engr., H. P. M. Birkinbine. Const. Engr., Harry Birkinbine. All labor done by day without Contrs.

Water Supply.—Missouri river, pumping to two subsiding reservoirs, and repumping to distributing reservoir.

Conduit.—When works were constructed, oak conduit, 3 x 4 ft., 2,300 ft. long, conveyed water from channel of river to pump-well.

Pumping Machinery.—Dy. cap., 7,500,000 galls.; Andrews centrifugal, driven by Westinghouse engines, and two Knowles dup., 30 x 16-in. steam, 24-in. water cylinders. Knowles pumps lift water from subsiding to distributing reservoir.

Subsiding Reservoirs.—Cap., 12,000,000 galls.; two of equal cap.

Distributing Reservoirs.—Cap., 4,000,000 galls.; on bluff.

Distribution.—*Mains*, c. i., 31 miles. *Services*, lead. Pipe and specials from Shickle, Harrison & Howard Iron Co., St. Louis, Mo. *Taps*, 1,940. *Meters*, kind not given, 247. *Hydrants*, Ludlow, Chapman, 227.

Consumption, 2,000,000 galls. *Pressure:* Ordinary, 82 lbs. Fire, 125 lbs.

Financial.—Cost, $798,000. Cap. stock, $1,000,000. Bonded debt, $750,000. Int., 6%. Ann. op. exp., $20,350. Ann. rev., consumers, $54,975; city, $22,025. Hydrant rental, $100 each for 200, $75 for additional.

Management.—Prest., Robt. Sewell. Secy., S. W. Hopkins, Jr. Treas., Geo. P. Sheldon. All of N. Y. City. Chf. Engr., Harry Birkinbine.

DAVENPORT, *Scott Co.* (Pop., 21,831; est., 31,000.) On Mississippi river, at foot of Upper rapids, opposite Rock Island, Moline and Milan, Ill.; at foot and on slope and top of bluff rising 180 ft. above low-water. At high-water river rises 18¾ ft. Settled in '36; incorp. city in '39. Has sewers and electric lights.

History.—Built in '74 by Davenport Water Co. under 25-years franchise. In '89 city renewed franchise for 25 years, reserving right to purchase works at end of

that time; if city does not then purchase works franchise is renewed for another 25 years, without further agreement. Co. is exempted from city taxes as offset to supplying city buildings, but city pays 10 cents per 1,000 galls. for water used to flush sewers, sprinkle streets, and at water troughs, except that 4 of the latter are supplied free.

Water Supply.—Mississippi river, by direct pumping, and by pumping to reservoir, there being high and low service; two pumping stations.

Intake.—Conduit of brick in cem., 3½ x 3 ft., extending under bed of river 250 ft. from low-water mark on the shore.

Pump-Well.—At end of conduit, 15 ft. diam. x 30 ft. deep.

Pumping Machinery.—*Main Station:* Dy. cap., 12,000,000 galls.; 6,000,000 Worthington, high-duty and 6,000,000 set of Clapp & Jones comp., cond., plunger, of 12-in. bore and 36-in. stroke. For 8 years two horizontal piston pumps, 17 x 72 ins., driven by two horizontal engines were used; pumps built by Todd & Rafferty, Paterson, N. J., and engines by M. Donahue, Davenport. *High Service Station:* 5,000,000, Clapp & Jones.

Reservoir.—Cap., 5,000,000 galls.

Distribution.—*Mains*, c. i., 33 miles. *Services*, galv. i. *Taps*, 1,710. *Meters* 50. *Hydrants*, kind not given, 320.

Consumption, 2,500,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 125 lbs.

Financial.—Cost (July 1, '89), $920,000. Cap. stock, $1,000,000. No debt. Ann. op. exp., withheld, est., $15,000. Ann. rev.: consumers, withheld, est., $50,000; city (in '87), about $12,000. Hydrant rental, $40.

Management.—Prest., Nicholas Kuhnen. V. Prest. and Secy., Jas. P. Donahue. Supt., Thos. N. Hooper.

DECORAH, *Winneshiek Co.* (Pop., 2,951; est., 3,500.) On Iowa river on rolling ground. Engaged in manufacturing. Settled in '51; incorp. city in '75. No sewers. Has electric lights.

History.—Built in '81 by city. Const. Engr. and Cont., G. E. Beach, Minneapolis, Minn.

Water Supply.—Surface well, pumping to reservoir, with provision for direct pumping. Well is 20 ft. diam. x 30 ft. deep, in gravel.

Pumping Machinery.—Dy. cap., 150,000 galls.; Knowles.

Reservoir.—Cap., about 400,000 galls.; 60 ft. diam. x 20 ft. deep; of stone in cem., with concrete bottom. Contrs., Haskins, Shultz & Kay, Decorah.

Distribution.—*Mains*, c. i., 2 miles. *Services*, galv. i. *Taps*, 50. *Meters*, none. *Hydrants*, Chapman, 18. *Valves*, Chapman.

Consumption, 32,000 galls. *Pressure*, 100 lbs.

Financial.—Cost, $23,000. Debt, $16,000. Int., 5 and 6%. Ann. op. exp., $1,000. Ann. rev., consumers, $1,000.

Management.—Com. Chn. and Supt., Alex. McKay.

DENISON, *Crawford Co.* (Pop., 1,441; est., 2,000.) On Boyer river. Incorp. No sewers. Has electric lights.

History.—Built in '83 by town. Engr., G. E. Beach, Minneapolis, Minn. Contrs., Northwestern Water & Gas Supply Co., Minneapolis, Minn.

Water Supply.—Surface well, pumping to tank.

Pumping Machinery.—Dy. cap., 250,000 galls.; dup., 12 x 6-in. First pump was Smith & Vaile, driven by windmill.

Tank.—Cap., about 100,000 galls.; 30 x 20 ft.; raised 40 ft. above ground, making its total elevation above town, 125 ft.

Distribution.—*Mains*, c. i., 1¼ miles. *Services*, w. i. *Taps*, 79. *Meters*, none. *Hydrants*, Chapman, 12. *Valves*, Chapman.

Consumption, 16,521 galls. *Pressure*, 35 lbs.

Financial.—Cost, $12,000. Debt, $7,500. Int., 6%. Ann. op. exp., $865. Ann. rev.: consumers, $450.

Management.—Com. Supt. and Chn., N. J. Wheeler.

DES MOINES, *Polk Co.* (Pop., 22,408; est., 45,000.) At junction of Des Moines and Raccoon rivers. Incorp. city in '57. Has sewers and electric lights.

History.—Built in '71 by Des Moines Water-Works Co., under perpetual charter. In '89 Co. bought franchise and works of No. Des Moines Water Co., which it now operates, supplying water from this plant. See No. Des Moines.

Water Supply.—Ground water on Raccoon river, direct pumping.

Filter.—Cylindrical iron chambers, 12 ft below bed of river, with tops tightly covered and bottoms open for water to filter in through sand and gravel. It is not stated whether this is now in use.

Pumping Machinery.—Dy. cap., 11,000,000 galls.; 5,000,000 Gaskill horizontal, 6,000,000 Worthington. Formerly, gang of 8 Holly piston pumps were used.

Distribution.—*Mains*, c. i., 60 miles. *Services*, lead. *Taps* (in '86), 2,500. *Meters*, 1,000. *Hydrants*, kind not given, 600. *Pressure-recording gauge*, Edson.

Consumption, 1,500,000 galls. *Pressure*, 80 to 135 lbs.

Financial.—(In '87.) Cost, $1,000,000. Cap. stock, $500,000. Bonded debt, $350,000. Int., 6%. Ann. op. exp. (in '86), $20,000. Ann. rev.: consumers (in '86), $20,000; city (in '86), hydrant rental, $650 per mile of main.

Management.—Prest., F. M. Hubbell. Secy. and Mgr., A. N. Denman. Treas., H. K. Love.

DUBUQUE, *Dubuque Co.* (Pop., 22,254; est., 30,000.) On Mississippi river on plateau in mining district. Founded in '33; incorp. in '41. Partially sewered. Has electric lights.

History.—Built in '71 by Dubuque Water Co. Des. Engr., —— Pilsbury.

Water Supply.—Abandoned tunnel for draining mines, by gravity to and from reservoir.

Tunnel.—In bluff 2½ miles from city, one mile long, from 100 to 200 ft. below surface and 80 to 90 ft. below mineral strata. Much of its course is through solid rock, from fissures in which water issues at temperature of 45°.

Conduit to Reservoir: arched channel, 6 ft. wide, 5 ft. high, 400 ft. long, extends from mouth of tunnel to reservoir, giving additional storage cap. of about 150,000 galls.

Dam.—Built across ravine to form reservoir. No further data.

Reservoir.—Cap., 1,600,000 galls.; 55 x 185 ft. by 18 ft. deep; 85 to 120 ft. above city. Surface water is excluded by stone walls; has rock bottom. *Discharge pipe:* 12-in. Does not leak. Built in '70. Engr., —— Rutherford. Cost, about $20,000.

Distribution.—*Mains*, c. i., 25 miles. *Services*, lead. *Taps*, 750. *Meters*, 10. *Hydrants*, Holly, 174. *Valves*, Ludlow.

Consumption, unknown. *Pressure*, 40 lbs

Financial.—Cost, withheld, est., $400,000. Cap. stock (in '81), $300,000. No bonds. Ann. op. exp., withheld, est., $5,000. Ann. rev.: consumers, withheld, est., $30,000; city, about $11,000. Hydrant rental, $75 for 100, $50 for additional.

Management.—Prest., S. Chamberlain. Secy., Treas. and Mgr., N. W. Kimball.

ELDORA, *Hardin Co.* (Pop., 1,584; est., 2,500.) On Iowa river. Manufactures wagons, pottery, tile and brick. Settled in '52; incorp. city in '58. No sewers or electric lights.

History.—Built in '83 by city. Engr., Wm. H. Burnham. Contrs., U. S. Wind Engine & Pump Co. Both of Batavia, Ill.

Water Supply.—Combined surface and driven well, pumping to tank. Well is 10 ft. diam. for 40 ft., then has 6-in. well driven 100 ft. deeper.

Pumping Machinery.—Dy. cap., 50,000 galls.; from U. S. Wind Engine & Pump Co.; 4x18 ins.; driven by 22-ft. Halladay windmill.

Tank.—Cap., about 100,000 galls.; 30x20 ft.; on timber trestle 40 ft. high.

Distibution.—*Mains*, c. i., 3,000 ft. *Services*, w. i. *Taps*, 7. *Meters*, none. *Hydrants*, Holly, 5.

Consumption, not given. *Pressure*, 26 lbs.

Financial.—Cost, $7,800. Debt, $6,000. Int., 7%. Sinking fund, $1,500. Ann. op. exp., $100. Ann. rev.: consumers, about $100.

Management.—Council. Secy, S. R. Edginton. Supt., H. E. Gardner.

FAIRFIELD, *Jefferson Co.* (Pop., 3,086; est., 4,000.) On Big Cedar river. Incorp. No sewers. Has electric lights.

History.—Built in '83-4 jointly by city, and Geo. B. Inman; city raised $25,000 by issuing bonds, and agreed to pay $4,000 yearly to Mr. Inman or assigns, all above int. on balance to apply to purchase of remainder of works. At present American Loan & Trust Co. are joint owners with city, balance due them Mar. 1, '89, being $23,168. Des. Engrs., C. B. Davis, Chicago, Ill., and Geo. B. Inman, N. Y. City, latter designing pumping plant and stand-pipe. Const. Engr., W. Kiersted, Kansas City, Mo. Contrs., Inman Bros., N. Y. City.

Water Supply.—Surface water, impounded by dam, pumping to stand-pipe.

Impounding Dam and Reservoir.—Cap., 100,000,000 galls.; area, nearly 20 acres. Dam of earth, with heart-wall; 490 ft. long, 35 ft. high, 8 ft. wide on top. Inner slope, 1¾ to 1, faced with plank; outer 1¼ to 1. *Heart-wall:* stone. *Spillways:* two. One, 90 ft. from west end, 13 ft. wide, lined with masonry and plank, free; slope, 1 to 1.6. Another, short distance from east end of dam, in earth. *Discharge-pipe:* 16-in.; slope, 1 ft. in 200. Does not leak. Built in '83. Engrs. and Contrs., see History. Cost, $15,000.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Blake, dup. *Boiler:* Kansas City.

Stand-Pipe.—Cap., 67,000 galls.; 12 x 80 ft.

Distribution.—(Mar. 1, '89.) *Mains*, c. i., 5.85 miles. *Services*, w. i. *Taps*, 202. *Meters*, 1. *Hydrants*, Ludlow, 33. *Valves*, Ludlow.

Consumption, 46,000 galls. *Pressure:* Ordinary, 27 lbs. Fire, 125 lbs.

Financial.—(Mar. 1, '89.) Cost, $60,253. Debt (see History), city bonds, $25,000. Ann. op. exp., $2,155. Ann. rev.: consumers, $1,500.

Management.—Water Com. of three. Supt., T. S. Higby.

FORT DODGE, *Webster Co.* (Pop., 3,586; est., 6,500.) On Des Moines river, and has water-power. No sewers. Has electric lights.

History. Built in '80-1 by city. Engr., T. N. Boutelle.

Water Supply.—Des Moines river, filtered, by direct pumping.

Filter.—Plate iron cylinder, 20 ft. diam., closed at top and open at bottom; sunk in gravel of river bottom. It has yielded 500,000 galls. a day. Water flows from filter to pump-well. A 14-in. pipe connects directly with river, and valve in it is automatically opened when capacity of filter is exhausted.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Cope & Maxwell (or Gordon) with 16x24-in. steam, 10-in. water cylinders.

Distribution.—*Mains*, c. i., 4½ miles. *Services*, w. i. *Taps*, 154. *Meters*, none. *Hydrants*, kind not given, 42.

Consumption, 250,000 galls. *Pressure:* Ordinary, 75 lbs. Fire, 120 lbs.

Financial.—Cost, $40,000. Debt, $36,000. Int., 6%. Ann. op. exp., $2,700. Ann. rev.: consumers, $3,420; city, tax for fire protection, $2,680.

Management. City Council. City Clerk, C. M. Hamilton.

FORT MADISON, *Lee Co.* (Pop., 4,679; est., 10,000.) On Mississippi river. Has extensive manufactories. Incorp. city. Partially sewered. Has electric lights.

History.—Built in '85 by Fort Madison Water Co., under 20 years exclusive franchise. Unofficially reported in '89 that these works, the gas and electric lighting plant had been bought by one Co. Engr., Geo. B. Inman. Contrs., Inman Bros. All of N. Y. City.

Water Supply.—Mississippi river, pumping to reservoir and direct.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Blake dup., comp., cond. *Boiler:* horizontal tubular.

Reservoir.—Cap., 1,500,000 galls.; 120 x 180 ft., x 16 ft. deep.

Distribution.—*Mains*, c. i., 9 miles. *Services*, w. i. *Taps*, 230. *Meters*, Crown, Hersey, 13. *Hydrants*, Ludlow, 87. *Valves*, Ludlow.

Consumption, 350,000 galls. *Pressure:* Ordinary, 70 lbs. Fire, 125 lbs.

Financial.—Cost, about $100,000. Cap. stock, $150,000. Bonded debt, $100,000. Int., 6%. Ann. op. exp., $3,600. Ann. rev.: consumers (in '87), $3,000; city, $5,820. Hydrant rental, $75 for 49, $60 for additional.

Management.—Prest., G. D. L'Huilier. Secy. and Treas., H. M. Gilligan. Both of 11 Wall St., N. Y. City. Supt., P. M. Hanley.

GLADBROOK, *Tama Co.* (Pop., est., 700.) On Wolf creek. Incorp. town in '80. No sewers or electric lights.

History.—Built in '83 by town. Contrs., Fairbanks, Morse & Co., Chicago, Ill.

Water Supply.—Artesian well, pumping to tank. Well is 2¼ ins. diam.: 216 ft. deep.

Pumping Machinery.—Dy. cap., 4,000 galls., "when the wind blows"; double-acting force pump driven by 12-ft. windmill.

Tank.—Cap., 30,000 galls.; 18x16 ft.; 40 ft. above pump.

Distribution.—*Mains*, Wyckoff wood, 1,200 ft. *Services*, iron. *Taps*, 3. *Hydrants*, Holly, 3.

Consumption, 800 galls.

Financial.—Cost, $1,000. Debt, $2,500. Int., 6%. Ann. op. exp., $150. Ann. rev.: consumers, $30.

Management.—Town Council. Secy., Wm. Meister. Supt., L. Wieland.

HAWARDEN, *Sioux Co.* (Pop., est., 500.) On Sioux river. Has manufactories. Incorp. town.

General Distribution.—Feb. 26, '90, town awarded contract for works to G. P. Wheeler, Beloit, Wis. Supply, driven wells, pumping to tank. Wells in strata of gravel about 25 ft. from surface, about 12 ft. deep. Dy. cap. of pump, 22,000 galls. Cap. of tank, about 60,000 galls.; wood, 24 x 18 ft. *Mains*, 6 and 4-in., 3,297 ft.; 72 ft. of latter; to pass under creek, 50 ft. wide, with bed 10 ft. below surface. *Hydrants*, 6. Contract price, $6,910. Com., W. W. Hall, Thos. G. Betts. Subject to correction, as report was made shortly after letting contracts.

HOLSTEIN, *Ida Co.* (Pop., est., 800.)

History.—Built in '86 for fire protection by town Contrs., U. S. Wind Engine & Pump Co., Batavia, Ill. **Water Supply.**—Well, pumping to tank. **Pumping Machinery.**—Dy. cap., not given; Knowles dup , with 8 x 12-in. steam, 6-in. water cylinders. **Tank.**—Cap., about 50,000 galls.; 19 x 24 ft. **Distribution.**—(In '87.) *Mains*, 6 and 4-in. c. i.. 1,600 ft. *Hydrants*, 4. **Financial.**—(In '87.) Cost, not given. Debt, $5,000. Int., 6%. **Management.**—Chn. Com., Wm. Wentz. Report by G. A. Case, Ida Grove.

NOTE.—No report for '89 could be obtained

IDA GROVE, *Ida Co.* (Pop., 759; est., 1,800.) On Maple river. Settled in '78; incorp. town in '79. Has sewers. No electric lights.

History.—Built in '82 by town. Des. Engr., Wm. H. Burnham. Contrs., U. S. Wind Engine & Pump Co. Both of Batavia, Ill.

Water Supply.—Driven wells, pumping to tank. There are 23 driven wells, first 11 being 2 ins. diam., varying in depth from 25 to 28 ft. They are connected to common suction pipe. Last 12 wells added in '88 or '89. As late as '85 water was also taken from surface well 8 ft. diam. x 18 ft deep.

Pumping Machinery.—Dy. cap., 90,000 galls.; 4 x 18-in., double-acting, driven by windmill; both furnished by Contrs.; Knowles of 12 x 12-in. steam, 8-in. water cylinders, used when there is no wind, or in case of fire.

Tank.—Cap., 100,000 galls.; 30x20 ft.; wood, on 20-ft. timber trestle.

Distribution.—*Mains*, c. i., 2 miles. *Services*, w. i. *Taps*, 85. *Meters*, none. *Hydrants*, Chapman, 11. *Valves*, Chapman.

Consumption 15,000 galls. *Pressure:* Ordinary, 45 lbs. Fire, 125 lbs.

Financial.—Cost, $10,800. Debt, $7,500. Int., 5%. Ann. op. exp., $480. Ann. rev.: consumers, $800.

Management.—Chn. Com., Geo. A. Case.

INDEPENDENCE, *Buchanan Co.* (Pop., 3 128; est., 3,450.) On Wapsipinicon river. Incorp. city. No sewers or electric lights.

History.—Built in '86-7 by town. Des. Engr., E. Smedley, Dubuque. Const. Engr., A. D. Guernsey, Independence. Contrs.. National Iron & Brass Works, Dubuque, and Denison & Cowell, Muscatine.

Water Supply.—Driven wells and Wapsipinicon river, direct pumping.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two 1,000,000 Smedley comp., cond., dup., built by Contrs. *Boilers:* two, horizontal, tubular.

Distribution.—*Mains*, heavy c. i., 5½ miles. *Services*, w. i. *Taps*, 90. *Meters*, Crown, Hersey, Worthington, 27. *Hydrants*, Ludlow, 40. *Valves*, Ludlow.

Consumption, 200,000 galls. *Pressure:* Ordinary, 65 lbs. Fire, 200 lbs.

Financial.—Cost, $40,000. Debt, $40,000. Int., 5%. Sinking fund, $3,000. Ann. op. exp., $3,555. Ann. rev.: consumers, $3,605.

Management.—Com. Secy., R. Brewer. Supt., A. D. Guernsey.

IOWA CITY, *Johnson Co.* (Pop., 7,123; est., 8,000.) On Iowa river on irregular ground, highest point being 105 ft. above river. Engaged in manufacturing. Settled in '39; incorp. city in '83. No sewers. Has electric lights.

History.—Built in '82 by Iowa City Water Co., under 20-years franchise. Engr., T. Cowell. Contrs., Denison & Cowell, Muscatine.

Water Supply.—Wells, 150 ft. deep, by direct pumping. Water formerly taken from Iowa river, passing through filter bed. It is not stated whether river water is now used.

Filter Bed.—Consists of 3 ft. of stone, gravel and sand in brick chamber 75x 14 ft.x12 ft. deep.

Pumping Machinery.—Dy. cap., 3,500,000 galls.; 1,000,000 Holly quadruplex, 1,500,000 Gaskill dup.; other not given.

Distribution.—*Mains*, c. i., 9½ miles. *Services*, w. i. Pipe and specials from Dennis Long & Co., Louisville, Ky. *Taps*, 285. *Meters*, 1 *Hydrants*, Holly, 93.

Consumption, 350,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 100 lbs.

Financial.—Cost, $125,000. Cap. stock, $55,000. Bonded debt, $70,000. Int., 6%. Ann. op. exp., $3,000. Ann. rev.: consumers, $4,000; city, $5,350. Hydrant rental, $60 for 70, $50 for additional.

Management.—Prest., G. B. Denison. Secy. and Treas., T. Cowell, both of Muscatine. Supt., J. Chatham.

KEOKUK, *Lee Co.* (Pop. 12,117; est., 18,000.) On Mississippi river, on limestone bluffs 130 ft. above river. Has extensive river commerce. Founded in '40. Incorp. Has sewers and electric lights.

History.—Built in 77-8 by Keokuk Water-Works Co., under 20-years franchise. Managed by American Water-Works Co., Ltd., Pittsburgh, Pa. Des. Engr., W. C. Stripe. Contrs., Denison & Cowell, Muscatine.

Water Supply.—Mississippi river, filtered, direct pumping. Water is aerated in passing down 12-mile rapids, above city, and surface drainage from other side of river is intercepted by canal built by U. S. Government.

Intake.—C. i., 20-in., extending from mid-channel to filter.

Filter.—Is 15 x 50 ft., brick in cem., with bottom 6 ft. below low water; floor of timber joists on edge, ¼ in. apart, was built 4 ft. above bottom, and on this is 2½ ft. of broken stone, charcoal, gravel, coarse and fine sand. Has worked fairly well.

Pumping Machinery.—Dy. cap., 3,500,000 galls.; 2,000,000 Holly, quadruplex with 14½ x 22-in. steam, 8-in. water cylinders, and 1,500,000 Worthington, comp.; a 2,000,000 Gordon reported by Mfrs.

Distribution.—*Mains*, c. i., 19 miles. *Services*, galv. i. *Taps*, 975. *Meters*, 50. *Hydrants*, kind not given, 150.

Consumption, 1,000,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 120 lbs.

Financial.—Cost, withheld, est., $350,000. Cap. stock (probably authorized), $500,000. Bonded debt, $200,000. Int., 6%. Ann. op. exp, withheld, est., $8,000. Ann. rev.: consumers, withheld, est., $22,000; city, about $11,000. Hydrant rental, $75.

Management.—Prest., J. H. Purdy. Secy., S. W. Highlands. Treas., J. T. Cockburn. Supt., O. O. Jones.

KNOXVILLE, *Marion Co.* (Pop., 2,577; est., 3,000.) Has water-power; in coal and timber region. Incorp. No sewers. Has electric lights.

History.—Built in '87 by town; put in operation Jan. 1, '88. Engr., A. A. Richardson, Lincoln, Neb.

Water Supply.—Source not given, pumping from reservoir to stand-pipe.

Reservoir.—Cap., 7,000,000 galls.; area, 4½ acres. Dam of earth, without heart-wall, 288 ft. long, 35 ft. high, 30 ft. wide on top.; both slopes, 1 to 1, unpaved. *Discharge-pipe:* 10-in.; level. Does not leak. Des. Engr., see History. Const. Engr., Wm. Jackson. Labor done by city. Cost, $5,300.

Pumping Machinery.—Dy. cap., 750,000 galls.; Blake, dup. *Boiler:* from H. C. Darby, Kansas City, Mo.

Stand-Pipe.—Cap., 93,000 galls.; 12x110 ft. Contr., H. C. Darby, Kansas City, Mo.

Distribution.—*Mains*, 10 to 4-in. c. i., 3 miles *Services*, w. i. Pipe and specials from Ohio Pipe Co., Columbus, O. *Taps*, 25. *Meters*, none. *Hydrants*, Galvin, Ludlow, 23. *Valves*, Galvin.

Consumption, 12,000 galls. *Pressure:* Ordinary, 45 lbs. Fire, 140 lbs.

Financial.—Cost, $28,000. Bonded debt, $23,500: $18,000 at 5, $5,500 at 6%. Ann. op. exp., $700. Ann. rev.: consumers, $200.

Management.—Mgr., T. G. Gilson.

LANSING, *Allamakee Co.* (Pop., 1,811; est., 1,800.) On Mississippi river. Incorp. No sewers or electric lights.

History.—Built in '77 by Lansing Artesian Well Co. Contrs., Snow Bros.

Water Supply.—Two flowing wells, by gravity.

Distribution.—*Mains*, c. i., ½ mile. *Services*, galv. i. *Taps*, 50. *Meters*, none. *Hydrants*, 7.

Consumption, 50,000 galls. *Pressure:* 45-ft. head.

Financial.—Cost, $8,000. Cap. stock, $4,200. No debt. Ann. op. exp., $125. Ann. rev.: consumers, $330; city, $240. Hydrant rental, $40 for 5, $20 for 2.

Management.—Prest., M. Kerndt. Secy. and Treas., J. W. Thomas. Supt., Ed. Boeckh.

LE MARS, *Plymouth Co.* (Pop., est., 5,000.) Incorp. city. No sewers or electric lights.

History.—Built in '88-9 by Le Mars Water & Light Co.; put in operation Feb. 1, '89. Engr., J. M. Dunn, Prest. and Supt. No Contrs. for labor.

Water Supply.—Driven wells, direct pumping; in case of fire water is pumped from reservoir.

Reservoir.—Cap., 250,000 galls.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two 1,000,000 Holly, comp., dup. *Boilers:* Holly.

Distribution.—*Mains*, 10 to 4-in. c. i., 7 miles. *Services*, ¾ to 1-in. galv. i. Pipe and specials from Detroit (Mich.) Pipe & Foundry Co. and So. St. Louis (Mo.) Foundry. *Taps*, 250. *Meters*, 2. *Hydrants*, 51.

Consumption, est., 150,000 galls. *Pressure:* Ordinary, 60 to 80 lbs. Fire, 100 to 120 lbs.

Financial.—Cost, $55,000. Bonded debt, $40,000. Ann. op. exp., $1,800. Ann. rev.: consumers, $27,000; city, $2,400. Hydrant rental, $48.

Management.—Prest. and Supt., J. M. Dunn. Secy. and Treas., Peter Egan, Jr. Report Oct. 11, '89.

LOGAN, *Harrison Co.* (Pop., 644; est., 1,000). On Boyer river. Incorp. town. No sewers or electric lights.

History.—Built in '84 by village.

Water Supply.—Two wells, pumping to reservoir.

Pumping Machinery.—Dy. cap., unknown. Power is furnished by windmill for each well; an 8-H. P. engine is also attached to one well, for use in emergency.

Reservoir.—Cap., about 90,000 galls.; on hill 100 ft. above street grade.

Distribution.—*Mains*, kal. i., w. i., 1½ miles. *Services*, galv. i. *Taps*, 10. *Meters*, none. *Hydrants*, 16.

Consumption, unknown. *Pressure*, 46 lbs.

Financial.—Cost, $7,400. Debt, $3,800. Int., 6%. Ann. op. exp., $240. Ann. rev.: consumers, $175.

Management.—Town Recorder, W. L. Stern. Supt., A. Stern.

LYONS, *Clinton Co.* (Pop., 4,095; est., 5,800.) On Mississippi river, two miles from Clinton. Has manufactories. Settled in '40; incorp. in '65. No sewers. Has electric lights.

History.—Built in '76 by Lyons Water-Works Co. Engr., W. C. Weir. Contract with city runs 23 years from '89.

Water Supply.—Mississippi river, pumping to reservoir and direct.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two Knowles, of 24 x 24-in. steam, 12-in water cylinders.

Reservoir.—Cap., not given; 100 ft. in diam., in excavation and embankment; lined with 2 ft. of puddled clay, on which is brick pavement.

Distribution.—*Mains*, c. i., w. i., 8 miles. *Services*, w. i. *Taps*, 250. *Meters*, none. *Hydrants*, some Mathews, 57.

Consumption, 250,000 galls. *Pressure:* Ordinary, 47 lbs. Fire, 150 lbs.

Financial.—Cost, $73,632. Cap. stock, $45,000. Debt, $21,200, of which $20,000 is in bonds. Int., 5½%. There is cash surplus of $18,422. Ann. op. exp., $2,500. Ann. rev.: consumers, $3,500; city, $3,750. Hydrant rental, $100 for 30, $50 for 15 additional, 12 free. City is limited to five-mill tax for fire protection, and as its assessed valuation is low it cannot pay full amount due for 40 hydrants; balance due each year is reckoned by company as debt against city; this debt amounts to $11,000, drawing 6% interest.

Management.—Prest., D. J. Batchelder. Secy., S. W. Gardiner. Treas., Wm. Holmes. Supt., H. D. Root.

McGREGOR, *Clayton Co.* (Pop., 1,602; est., 1,800.) On Mississippi river. Has railroad repair shops.

General Description.—The McGregor Artesian Well Co. has ¾ miles of pipe laid through business part of town, with 5 hydrants. Date built, not given. Used for fire protection only. No rev. Prest., J. P. Patrick.

MAQUOKETA, *Jackson Co.* (Pop., 2,467; est., 3,300.) On Maquoketa river. Has manufactories. Incorp. No sewers. Has electric lights.

History.—Built in '83-4 by city. Des. Engr., Geo. C. Morgan, Chicago, Ill. Const. Engr. and Contr., Travers Daniels, deceased.

Water Supply.—Well, pumping to stand-pipe and direct. Well is in sand, 500 ft. from river; 22 ft. diam. x 30 ft. deep, and lined with brick.

Pumping Machinery.—Dy. cap., 1,500,000 galls.: Blake, dup., with 12-in. steam cylinders, 10-in. plungers.

Stand-Pipe.—Cap., about 60,000 galls.; 12½ x 80 ft.; w. l.; 175 ft. above, ¾ miles from, pump.

Distribution.—*Mains*, 8 to 4-in. c. I., 2.6 miles. *Services*, w. i. Pipe and specials from Ohio Pipe Co., Columbus, O., and National Tube Works Co., Chicago, Ill. *Taps*, 120. *Meters*, none. *Hydrants*, Ludlow, 28. *Valves*, Ludlow.

Consumption, 60,000 galls. *Pressure:* Ordinary, 65 lbs. Fire, 90 lbs.

Financial.—Cost, $33,297. Bonded debt, $18,500. Int., 6%. Ann. op. exp., $1,268. Ann rev.: consumers, $1,055; city, by taxation, $1,735.

Management.—Three Comrs. Secy., D. A. Fletcher. Treas., H. B. Hubbell.

MARENCO, *Iowa Co.* (Pop., 1,738; est., 2,000.) On Iowa river. Has electric lights.

History.—Built in '75 by village, for fire protection only. **Water Supply.**—Iowa river, direct pumping. **Pumping Machinery.**—Dy. cap., not given; Worthington. Pump is placed in building near a mill and connected with its water-wheel and engine. **Distribution.**—*Mains*, iron, 2 miles. *Hydrants*, D. C. Cregier, Patent, 10. *Pressure*, 150 lbs. **Financial.**—Cost, $10,000. Ann. op. exp., "very small." No rev. **Management.** -Town Council. Supt., Jno. Schafbuck. Engr., W. S. Dillin, owner of mill.

MARION, *Linn Co.* (Pop., 1,939; est., 4,500.) Railroad center, 6 miles from Cedar Rapids. Incorp. city. Partially sewered. No electric lights.

History.—Built in '84-5 by Jesse W. Starr, Jr., Philadelphia, Pa., under 25-years franchise, and corporate name of Marion City Water Co.; reorganized in '87.

Water Supply.—Bowman and Davis springs, pumping from receiving reservoir to stand-pipe and direct. Indian creek connected with pumps for reserve supply. Bowman spring has dy. cap., of 1,800,000 galls; Davis, 225,000 galls.; Indian creek, in dry weather, 7,000,000 galls.

Collecting Conduit.—W. i., 12-in.

Receiving Reservoir.—Dy. cap., 600,000 galls.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two Worthington, comp., dup.

Stand-Pipe.—Cap., 14,700 galls.; 5 x 100 ft.

Distribution.—*Mains*, 12 to 4-in. c. I., 9 miles. *Services*, w. i., galv. i. *Taps*, (Jan. 1, 90), 143. *Meters*, kind not given, 2. *Hydrants*, Chapman, 58. *Valves*, Chapman.

Consumption, 200,000 galls. *Pressure:* Ordinary, 50 lbs. Fire, 120 lbs.

Financial.—Cost, $127,000. Ann. op. exp., $2,500. Ann. rev., withheld. Hydrant rental $60 for first 50, $30 thereafter.

Management.—Prest., Saml. Saylor. Secy. and Gen. Mgr., L. M. Rupert. Treas., A. L. Daniels. Supt., B. F. Seaton.

MARSHALLTOWN, *Marshall Co.* (Pop., 6,240; est., 10,000.) On Iowa river. Engaged in manufacturing and trade. Incorp. in '68. Has sewers and electric lights.

History.—Built in '76 by city. Engr., Thos. N. Boutelle. Contrs., S. D. Carpenter & Co., Ottumwa. Electric light system is owned and operated by city in connection with water-works.

Water Supply.—Iowa river, filtered, by direct pumping. River flows through alluvial soil.

Filter.—A 16-in. pipe extends from river to basin 20 x 30 ft., x 15 ft. deep, in which is gravel and charcoal.

Pumping Machinery.—Dy. cap., 2,500,000 galls.: two Knowles, with 22 x 24-in. steam, 12-in. water cylinders.

Distribution.—*Mains*, c. i., 12½ miles. *Services*, iron, lead. Pipe and specials from Dennis Long & Co., Louisville, Ky. *Taps*, 475. *Meters*, 1. *Hydrants*, Chapman, 90. *Valves*, Chapman.

Consumption, 644,131 galls. *Pressure:* Ordinary, 65 lbs. Fire, 100 lbs.

Financial.—Cost, $106,049. Debt, $37,000. Int., 8%. Ann. op. exp., $5,292. Ann. rev.: consumers, $7,000.

Management.—Secy. and Gen. Mgr., J. G. Trotter.

MASON CITY, *Cerro Gordo Co.* (Pop., 2,510; est., 3,500.) On Lime river. Incorp. No sewers. Has electric lights.

History.—Built in '85 by town. Des. Engr., C. B. Davis, Chicago, Ill. Const. Engr., Jno. West, Mason City.

Water Supply.—Springs and Lime river, by direct pumping. River is drawn upon in case of fire. Supply is insufficient and plans for its increase were considered in '85.

Receiving Reservoir.—Cap. previous to enlargement in '89, about 150,000 galls. Springs are at foot of hill, and water is led from them to reservoir.

Pumping Machinery.—Dy. cap. 1,500,000 galls.; two Blake dup., each having 8½-in. plungers of 12-in. stroke, one being driven by comp. engine with 8½ and 12-in. cylinders, and other by engine with 16-in. cylinder, all of 12-in. stroke.

Description.—*Mains*, c. i., 2¾ miles. *Services*, lead, galv. i. Pipe and specials from Shickle, Harrison & Howard Iron Co., St. Louis, Mo. *Taps*, 125. *Meters*, 4. *Hydrants*, Ludlow, 26. *Valves*, Ludlow.

Consumption, 185,000 galls. *Pressure:* Ordinary, 75 lbs. Fire, 125 lbs.

Financial.—Cost, $28,000. Bonded debt, $26,000. Int., 6%. Ann. op. exp., $2,657. Ann. rev.: consumers, $3,407; water tax, $1,518; charged to city for hydrants, $1,875.

Management.—Chn. Water Board, C. H. Tondro. City Clerk, A. R. Sale.

MISSOURI VALLEY, *Harrison Co.* (Pop., 1,154; est., 4,000.) Is 6 miles from Missouri river, 20 from Council Bluffs. Has manufactories. Incorp. No sewers. Has electric lights.

History.—Built in '89 by city; put in operation about Jan. 1, '90. Engr., J. S. Wattles, City Engr. Contrs., Fremont Foundry & Machine Co., with C. H. Godfrey in charge.

Water Supply.—Ten driven wells, pumping to reservoir.

Pumping Machinery.—Dy. cap., about 750,000 galls.; Smedley; high-pressure cylinders, 9, low, 14, water, 8 ins. in diam., all 15-in. stroke. *Boiler:* 5 x 14 ft.

Reservoir.—Cap., 200,000 galls.; 60 ft. in diam., 12 ft. deep; 220 ft. above pump.

Distribution.—*Mains*, 12 to 6-in., 1½ miles. *Hydrants*, 13.

Pressure: Ordinary, 100 lbs. Fire, 160 lbs.

Financial.—Cost, about $16,000.

Management.—City Engr., J. S. Wattles. Report, about Jan. 1, '90.

MONTICELLO, *Jones Co.* (Pop., 1,877; est., 2,000.) On Maquoketa river, on elevated terrace called "second bottom." Has furniture and other factories. Settled in '53; incorp. in '67. No sewers or electric lights.

History.—Built in '78 by city. Des. Engr., Thos. N. Boutelle. Contrs., Pond Engineering Co., St. Louis, Mo.

Water Supply.—Artesian well, pumping to reservoir. Well 1,200 ft. deep, extending 40 ft. into Potsdam sandstone.

Pumping Machinery.—Dy. cap., 230,000 galls.; No. 9 Blake. *Boiler:* 30-H. P. Both from Contrs. Nov., '89, Smedley dup. pump was being added.

Reservoir.—Cap., est., 500,000 galls.; 80 ft. in diam., 20 ft. deep; 100 ft. above town; lined with masonry. Does not leak. Built in '78. Engr. and Contrs., see History.

Distribution.—*Mains*, c. i., 3 miles. *Services*, galv. i. *Taps*, 215. *Meters*, none. *Hydrants*, Holly, 24.

Consumption, 60,000 galls. *Pressure*, 45 lbs.

Financial.—Cost, $20,000. Debt, $7,000. Int. 5½%. Ann. op. exp., $1,200. Ann rev.: consumers, $2,000; city $1,500.

Management.—Three Commrs. Prest., A. Kemp. Secy., F. Coop. Supt., J. D. Graves

MOUNT PLEASANT, *Henry Co.* (Pop., 4,410; est., 4,000.) Manufactures scales and wheel-scrapers. Incorp. Has sewers. No electric lights.

History.—Built in '81 by Mount Pleasant Water-Works Co. Contrs., Inman Bros., N. Y. City.

Water Supply.—Big creek, filtered, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., not given; two Blake, one dup., and one high-pressure.

Filter.—Dy. cap., 300,000 galls.; Hyatt.

Stand-Pipe.—Cap., 39,000 galls.; 10 x 80 ft.

Distribution.—*Mains*, c. i., 6 miles. *Services*, w. l. Pipe and specials from Addyston (O.) Pipe and Steel Co.; trenching and pipe-laying done by R. B. Carothers, Newport, Ky. *Taps*, 66. *Meters*, 5. *Hydrants*, Ludlow, 50. *Valves*, Ludlow.

Consumption, 100,000 galls *Pressure:* Ordinary, 35 lbs. Fire, 80 lbs.

Financial.—Cost, withheld, est., $75,000. Cap. stock (in '88), $130,000. Debt and int., withheld. Ann. op. exp., withheld, est., $3,000. Ann. rev.: total, withheld, est., $7,000. Hydrant rental, withheld.

Management.—Prest. and Treas., H. M. Phillips, Springfield, Mass. Secy., J., H. Hewson, N. Y. City. Supt., C. M. Glover.

MUSCATINE, *Muscatine Co.* (Pop., 8,295; est., 12,000.) On Mississippi river, on rocky bluff. Has extensive trade and manufactories. Settled in '36; incorp. city in '53. Partially sewered. Has electric lights.

History.—Built in 75-6 by Muscatine Water Works Co., under 30-years franchise. Des. Engr., Wm. C. Weir. Const. Engr., T. E. Cowell, Muscatine. Contrs., Denison & Cowell, Muscatine.

Water Supply.—Mississippi river, filtered, pumping to reservoir and direct.

Filter.—Gravel, 15 ft. sq.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; two Cope & Maxwell (or Gordon), direct-acting, with 16 x 30-in. steam cylinders, 10-in. water plungers.

Reservoir.—Cap., 2,000,000 galls.; in excavation and embankment, 18 ft. deep, 172 ft. above high water. Inner slopes, 1½ to 1, covered with puddle, lined with brick in cem.

Distribution.—*Mains*, c. i., 6 miles. *Services*, w. i., lead. *Taps*, 350. *Meters*, 40. *Hydrants*, Chapman, Ludlow, 60. *Valves*, Chapman, Ludlow.

Consumption, 300,000 galls. *Pressure:* Ordinary, 72 lbs. Fire, 150.

Financial.—Cost, $95,000. Cap. stock, $33,000. Bonded debt, $27,000. Int., 5%. Ann. op. exp., est., $7,000. Ann. rev.: consumers, est., $7,000; city, est., $5,500. Hydrant rental, $75.

Management.—Prest., Alex. Jackson. Secy., J. Carscaddan. Supt., W. Molis.

NEOLA, *Pottawattamie Co.* (Pop., 668; est., 800.) Incorp. No sewers or electric lights.

History.—Built in '87 by village, for fire protection only. Des. Engr., —— Fairbanks, St. Louis, Mo. Const. Engr., S. K. Felton, Omaha. Contrs., U. S. Wind Engine & Pump Co., Batavia, Ill. **Pumping Machinery.**—Dy. cap., 450,000 galls.; Knowles. *Boiler:* Porter. **Water Supply.**—Well, pumping to tank and direct. **Tank.**—Cap., about 60,000 galls. **Distribution.**—*Mains*, c. i., 0.8 miles. *Services*, lead. *Taps*, 15. *Meters*, none. *Hydrants*, Eclipse 7. *Valves*, Galvin. *Consumption*, not given. *Pressure:* Ordinary, 60 lbs. Fire, 100 lbs. **Financial.**—Cost, $5,500. Debt, $3,000. Int., 6%. Ann. op. exp., $400. Ann. rev.: consumers, $260. **Management.**—Secy., H. T. Irwin. Supt., Wm. Sells.

NEVADA, *Story Co.* (Pop., 1,541; est., 1,690.) Incorp. Has sewers. No electric lights.

History.—Built in '88 by village. Des. Engr., Wm. Burnham, Batavia, Ill. Const. Engr. and Contr., Fremont Turner, Nevada.

Water Supply.—Well, pumping to tank.

Pumping Machinery.—Dy. cap., 644,000 galls.; Curtis, driven by windmill; 500,000 Deane, dup., added in '89.

Tank.—Cap., 97,000 galls.; 30 x 20 ft.; wooden, on wooden trestle; tank about 110 ft. above and 2,550 ft. from pump.

Distribution.—*Mains*, 8 and 6-in. c. i., 1¼ miles. *Services*, iron. Pipe from Detroit (Mich.) Pipe and Foundry Co. *Taps*, 36. *Meters*, none. *Hydrants*, Galvin, 18. *Valves*, Galvin.

Consumption, not known. *Pressure*, 43 to 50 lbs.

Financial.—Cost, $12,000. Bonded debt, $12,000. Int., 5½%. Ann. op. exp., about $100. Ann. rev., not determined.

Management.—Com. of 3. Supt., F. Turner.

NEWTON, *Jasper Co.* (Pop., 2,607; est., 3,500.) Incorp. No sewers. Has electric lights.

History.—Built in '84 by town. Des. Engr., Jos. Stevens. Const. Engr., Fairbanks, Morse & Co., Chicago, Ill. Contr. for pumping machinery, pipe and specials, A. K. Brown; for pipe-laying, Wesley Roberts.

Water Supply.—Artesian well, pumping to reservoir. Well is 1,380 ft. deep, cased with 5 5 8-in. pipe for 1,230 ft.

Pumping Machinery.—Dy. cap., not given; Smith & Vaile. *Boiler:* upright.

Reservoir.—Cap., about 100,000 galls.

Distribution.—*Mains*, 1 mile. *Taps*, 10. *Hydrants*, 14.

Consumption, not given. *Pressure:* Ordinary, 60 lbs. Fire, 120 lbs.

Financial.—Cost, $20,000. Debt, $16,000. Int., 6%. Ann. op. exp., not given; est., $500. Ann. rev.; none at present.

Management.—Mayor, Jos. Stevens.

NORTH DES MOINES, *Polk Co.* (Pop., not given.) Near Des Moines.

General Description.—Built in '88-9 by North Des Moines Water Co. Contrs., Dunham & Paine, Cleveland, O. Supply, source not given, pumping. *Mains*, 10 to 6-in., about 5 miles. After completing works as above, holders of franchise sold franchise

and works to Des Moines Water Co., which petitioned council to modify charter so that supply could be from its plant in Des Moines. Council refused request, enjoined Co. from making connections to take such supply, and town voted 215 to 20 to build and operate works. Compromise was made prior to Feb. 10, '90, by which supply comes from Des Moines Water Co.'s plant, and city pays $500 a mile for fire protection, in stead of $1,000, as originally provided. Reports by John MacVicar, Mayor. Address Des Moines Water Co., Des Moines.

ODEBOLT, *Sac Co.* (Pop., 637; est., 1,200.) On Odebolt creek, on rolling prairie. Settled in '77. Incorp. No sewers or electric lights.

History.—Built in '84 by Odebolt Water-Works Co. Des. Engr., Wm. H. Burnham. Contrs., U. S. Wind Engine & Pump Co., Batavia, Ill.

Water Supply.—Driven wells, pumping to tank. Water was formerly taken from well 6 ft. diam., 30 ft. deep.

Pumping Machinery.—Dy. cap., not given; Knowles steam; also 4x18-in. pump, driven by 22-ft. windmill.

Tank.—Cap., 58,000 galls.; 18x24 ft.; on 40-ft. timber trestle; ground being 60 ft. above town.

Distribution.—*Mains*, c. i., 1½ miles. *Services*, w. i. *Taps*, 24. *Meters*, none. *Hydrants*, Bailey, 10. *Valves*, Eddy.

Consumption, 5,000 galls. *Pressure*, 60 lbs.

Financial.—Cost, $10,000. Cap. stock, $20,000. No debt. Sinking fund, $250. Ann. op. exp., $180. Ann. rev.: consumers, $300; city, $500. Hydrant rental, $50 each.

Management.—Com. Chn., Jos. Mattes.

OSKALOOSA, *Nahaska Co.* (Pop., 4,598; est., 10,000.) Engaged in manufacturing and coal mining. Incorp. Has sewers and electric lights.

History.—Built in '80-1 by Oskaloosa Water Co., under 20-years franchise. Contrs., Denison & Cowell, Muscatine.

Water Supply.—Surface water, filtered, pumping to stand-pipe and direct.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; 1,500,000 and 1,000,000 Holly quadruplex, 500,000 Deane. *Boilers:* Holly.

Filter.—Dy. cap., 500,000 galls.; Hyatt.

Stand-Pipe.—Cap., 280,000 galls.; 20x120 ft.; steel; from Shickle, Harrison & Howard Iron Co., St. Louis, Mo.

Distribution.—*Mains*, c. i., 14 miles. *Services*, galv. i., black i. Pipe and specials from Shickle, Harrison & Howard Iron Co. *Taps*, 452. *Meters*, 16. *Hydrants*, Chapman, Holly, 60. *Valves*, Eddy.

Consumption, 500,000 galls. *Pressure:* Ordinary, 45 lbs. Fire, 90 lbs.

Financial.—(In '87.) Cost, about $150,000. Cap. stock, $250,000. Bonded debt $150,000. Int., 6%. Ann. op. exp., $5,500. Ann. rev.: consumers, $8,000; city, $4,900 Hydrant rental, $100 for 40, $50 for additional.

Management.—Prest., Jas. Gamble, N. Y. City. Treas., H. L. Spencer. Supt., Chas. C. Craig.

OTTUMWA, *Wapello Co.* (Pop., 9,001; est., 14,000.) On Des Moines river, which at this point falls 10 ft. in ½ mile, affording valuable water-power used in manufacturing. Settled '44; incorp. village in '51, city in '57, and reorganised in '68. Has sewers and electric lights.

History.—Built in '77-8 by Iowa Water Co., under 20-years franchise. Des. Engr., S. L. Wiley, Omaha, Neb. Const. Engr., E. C. Cooke, Tiffin, O. Contr., Wiley Const. Co., Omaha, Neb.

Water Supply.—Des Moines river, water passing through canal to settling basin, thence to pump-well, from which it is pumped to reservoir.

Canal and Settling Basin: canal is 40 ft. wide, 4,000 ft. long; settling basin, 180 x 220 ft.

Old Filter.—(*Not in use.*) See MANUAL for '88, p. 417.

Pumping Machinery.—Dy. cap., 5,000,000 galls.; two Flanders, water-power, and one Knowles. *Boilers:* horizontal, tubular.

Reservoir.—Cap., 2,000,000 galls.; 98 x 132 ft.; 201 ft. above city.

Distribution.—*Mains*, c. i., 15 miles. *Services*, w. i., lead. Pipe and specials from Shickle, Harrison & Howard Iron Co., St. Louis, Mo., and R. D. Wood & Co., Philadelphia, Pa. *Taps*, 615. *Meters*, 15. *Hydrants*, Holyoke, 100. *Valves*, Chapman.

Consumption, 1,500,000 galls. *Pressure*, 85 lbs.

Financial.—Hydrant rental, $75. All other data withheld. *Estimates:* Cost, $245,000. Ann. op. exp., $5.000. Ann. rev.: consumers, $16,090; city, $7,500.

Management.—Prest., W. A. Underwood. Supt. and Secy., W. McCue.

RED OAK, *Montgomery Co.* (Pop., 3,755; est., 4,000.) On Nishnabotna river on undulating prairie. Settled in '64; incorp. village in '68. No sewers. Electric lights projected in '89.

History.—Built in '80-1 by village. Engr. and Contr., P. B. Perkins, Springfield, Ill.

Water Supply.—Filter gallery, by direct pumping. In case of fire water is taken from river.

Filtering Gallery.—A 24-in. vitrified pipe, 200 ft. long, with 40 1-in. holes in bottom of each length; laid 25 ft. below surface, in gravel.

Pumping Machinery.—Dy. cap., 800,000 galls.; two Smith & Vaile, with 16 x 18-in. steam, 8-in water cylinders.

Distribution.—*Mains*, c. i., 8 miles. *Services*, w. i. *Taps*, 210. *Meters*, 16. *Hydrants*, Pattee, Perkins, 46.

Consumption, 400,000 galls. *Pressure:* Ordinary, 80 lbs. Fire, 110 lbs.

Financial.—Cost, $32,800. Bonded debt, $21,000. Int., 5%. Sinking fund, $500. Ann. op. exp., $3,473. Ann. rev.: consumers, $3,613.

Management.—Supt., R. Woodsworth. Report by O. P. Worsley.

REINBECK, *Grundy Co.* (Pop., 482; est., 900.)

History.—Built in '83 by village for fire protection. Contrs., Fairbanks, Morse & Co., Chicago, Ill. **Water Supply.**—Well, pumping to tank. Well is 6 ft. diam. for 20 ft., then a 3-in. pipe extends 43 ft. deeper. **Pumping Machinery.**—Dy. cap., 20,000 galls.; driven by windmill. **Tank.** Cap., about 20,000 galls.; 20 x 16 ft.; on 20-ft. timber trestle; bottom of tank is about 80 ft. above hydrants. **Distribution.**—*Mains*, Wyckoff, 1 mile. *Hydrants*, 6. **Financial.**—(In '87.) Cost, $3,800. Debt, $2,200. Int., 7%. Ann. op. exp., $75. No rev. **Management.** Not given. Report by J. B. Gillespie, who says the works "are an elephant on hands of city."

NOTE.—No report could be obtained for '89.

ROCK RAPIDS, *Lyon Co.* (Pop., est., 2,000.) On Rock river. Incorp. town. No sewers or electric lights.

History.—Construction begun Nov. 1, '89, by Rock Rapids Water Co., under 21-years franchise. Reported Nov. 18, '89 that works would be in operation June 15, '90. Engr., J. J. Nesbit, Larned, Kan.

Water Supply.—Fifty "drive points," pumping to stand-pipe.

Pumping Machinery.—No data.

Stand-Pipe.—Cap., 37,600 galls.; 8x100 ft.

Distribution.—*Mains*, 10 to 4-in. c. i., 3¼ miles. *Hydrants*, 25.

Pressure: Ordinary, 70 lbs. Fire, 125 lbs.

Financial.—Cap. stock, $60,000. Hydrant rental, $1,500 for all, or $60 each.

Management.—Prest., E. E. Frizell. Secy., W. C. Hilts. Treas., W. S. Park. All of Larned, Kan.

NOTE.—Subject to correction, as report was made just after construction was begun.

SIOUX CITY, *Woodbury Co.* (Pop., 7,366; est., 30,000.) On Missouri river. Has extensive manufactories, trade and packing houses. Incorp. city. Has sewers and electric lights.

History.—Built in '84-5 by City Water-Works Co.; put in operation Jan. 12, '85; owned and operated by city since July, '85. Des. Engr., W. C. Stripe, Keokuk. Const. Engr., —— Elliott. Contr. for masonry and buildings, E. W. Wakefield.

Water Supply.—Driven wells, pumping to reservoir. There are 104 2-in. wells, in gravel about ¼ mile from Missouri river; av. depth, 72 ft.; 12-ft points, each perforated with 310 ⅛ in. holes; dy. yield, 2,000,000 galls. Direct pumping, surplus passing to reservoir, used prior to '89, when independent supply main was built.

Pumping Machinery.—Dy. cap., 4,000,000 galls; two 2,000,000 Gaskill horizontal.

Force Main.—No data.

Reservoir.—Cap., 1,500,000 galls.; in city, 264 ft. above business section. Contrs. McRitchie & Nichol, Chicago, Ill. Cost, $14,000.

Supply Main.—Diam., 12 ins.; length, about 1½ miles. Cost, $12,515.

Distribution.—*Mains*, c. i., 22 miles. *Services*, lead. Pipe and specials from Dennis Long & Co., Louisville, Ky.; trenching and pipe-laying done by McRitchie & Nichol. *Taps*, 1,925. *Meters*, 00. *Hydrants*, Mathews, 130. *Valves*, Ludlow.

Consumption, 1,250,000 galls. *Pressure*, 100 lbs.

Financial.—(Mar. 1, '89.) Cost (Jan. 1, '90), $254,206. Debt, $185,000. Int., 6%. Sinking fund, $4,000. Ann. op. exp., $8,000. Ann. rev.: consumers, $16,757.

Management.—Secy., C. H. Edwards. Supt., J. F. Sullivan.

SIOUX RAPIDS, *Buena Vista Co.* (Pop., est., 900.) On Little Sioux river. Incorp. town. No sewers or electric lights.

History.—Construction was to be begun April 1, and finished by June 1, '90, by town. Engr., G. A. Mitchell, Cedar Rapids. Contr., E. P. Wheeler, Beloit, Wis.

Water Supply.—Well, pumping to tank. No filtration.

Pumping Machinery.—No data.

Tank.—Cap., 50,000 galls.

Distribution.—*Mains*, 6-in. iron, 1½ miles. *Services*, ¾-in. galv. i. *Taps*, 40. *Meters*, none. *Hydrants*, Mathews, 8. *Valves*, Eddy.

Financial —Cost, est., $6,000. Bonded debt, $5,000. Int., 5½%.

Management.—No data. Report by Jas. M. Hoskins Mayor; date, Mar. 7, '90.

NOTE.—Subject to correction, as report was made before construction was begun.

STATE CENTRE, *Marshall Co.* (Pop., 880; est., 1,500.) On level plateau which forms divide between Iowa and Skunk rivers. Settled in '59; incorp. city in '69.

History.—Built in '77 by city. Engr. and Contr., G. E. Beach, Minneapolis, Minn. In '89 extensions were made and tank built by U. S. Wind Engine & Pump Co., Batavia, Ill.

Water Supply.—Two wells, 58 ft. deep, pumping to tank.

Pumping Machinery.—Dy. cap., about 70,000 galls.; three 3 x 10½-in. deep-well pumps, driven by two windmills.

Tank.—Cap., 64,000 galls.; 24 x 24 ft.; on 30 ft. timber trestle.

Distribution.—*Mains*, 6-in. c. i., 1 mile. Pipes and specials from Shickle, Harrison & Howard Iron Co., St. Louis, Mo. *Services*, w. i. *Taps*, 9. *Meters*, none. *Hydrants*, Ludlow, 11.

Consumption (in '87), 1,500 galls. *Pressure*, 20 lbs.

Financial.—(In '87.) Cost, $10,000. Debt, $6,000. Ann. op. exp., $100. Ann. rev.: consumers, $25.

Management.—(In '88.) Supt., G. G. Bassett.

TIPTON, *Cedar Co.* (Pop., 1,299; est., 1,800.) Is 5 miles from Cedar river. Incorp. city. Has electric lights.

History.—Built in '89 by city; put in operation July 1. Engr. and Contr., Geo. C. Morgan, Chicago, Ill.

Water Supply.—Artesian well, pumping to stand-pipe. Well sunk in '88; 2,700 ft. deep; water (in '88) 70 ft. below surface.

Receiving Reservoir.—Cap., 27,000 galls.

Pumping Machinery.—No data.

Stand-Pipe.—Cap., 20,000 galls.; Morgan's special tower, consisting of stand-pipe on brick tower.

Distribution.—*Mains*, 8 and 6-in., 1.614 ft. *Taps*, 7. *Hydrants*, 5.

Financial.—Cost, $18,400. Bonded debt, $18,400.

Management.—No data. Report by A. Langham; date, July 14, '89.

VILLISCA, *Montgomery Co.* (Pop., 1,299; est., 2,500.) Incorp. town. Partially sewered. No electric lights.

History.—Built in fall of '86 by town. Contrs., U. S. Wind Engine & Pump Co., Batavia, Ill.

Water Supply.—Wells, supplied by springs, pumping to tank.

Pumping Machinery.—Dy. cap., not given; Knowles.

Tank.—Cap., 47,000 galls.; 20x20 ft.

Distribution.—*Mains*, 6-in. iron, 1¼ miles. *Taps*, 108. *Hydrants*, 11. *Pressure*, 60 lbs.

Financial.—Cost, $13,000. Debt, $12,000. Int., 6%. Ann. op. exp., $360. Ann. rev: consumers, about $360.

Management —No data. Report by C. C. Waterman; date, Apr. 5, '90.

VINTON, *Benton Co.* (Pop., of township, 2,906; of village, est., 2,700.) On Red Cedar river. Has some manufactories. Incorp. No sewers or electric lights.

History.—Built in '88, put in operation Jan. 1, '89, by town. Engrs., Loweth & Curtis, St. Paul, Minn. Contrs. for entire plant, except well, Denison & Cowell, Muscatine.

Water Supply.—Artesian well for domestic use. Cedar river for fire protection, direct pumping. Unofficially reported that another artesian well was being sunk in '89.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; two 750,000 Gordon comp., cond.

Distribution.—*Mains*, 2.8 miles. Pipe and specials from Shickle, Harrison & Howard Iron Co., St. Louis, Mo. *Taps* (June 15, '89), 50. *Meters*, none. *Hydrants*, Bourbon, 41. *Valves*, Bourbon

Consumption, not determined. *Pressure:* Ordinary, 40 lbs. Fire, 150 lbs.

Financial.—Cost, $29,000. Bonded debt, $28,000. Int., 5%. Ann. op. exp., est., $1,200. Ann. rev., not determined.

Management.—City Council. Pumpg. Engr., Geo. Hayes. Report by J. E. Marietta, Chn. Finance Com.

WATERLOO, *Black Hawk Co.* (Pop., 5,639; est., 7,000.) On Cedar river. Has various manufactories. Incorp. No sewers. Has electric lights.

History.—Built in '86 by Waterloo Water-Works Co., under 20 years franchise. Engr., T. E. Cowell, of Denison & Cowell, Muscatine, who were Contrs. and owned works early part of '89. Unofficially reported latter part of '89 that the bondholders had bought works for $83,000 and re-organized Co.

Water Supply.—Cedar river, by direct pumping.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; Gordon & Maxwell, comp.

Distribution.—*Mains*, c. i., 9¾ miles. *Services*, w. i., lead. Pipe and specials from Ohio Pipe Co., Columbus, O. *Taps*, 360. *Meters*, 2. *Hydrants*, Ludlow, 111. *Valves*, Ludlow.

Consumption, 350,000 galls. *Pressure:* Ordinary, 50 lbs. Fire, 80 to 100 lbs.

Financial.—Cost, $89,000. Cap. stock, $125,000. Bonded debt, $70,000. Int., 6%. Ann. op. exp., $4,200. Ann. rev.: consumers, $2,800; city $4,000. Hydrant rental, $40.

Management.—(June 10, '89.) Prest., G. B. Denison. Secy. and Treas., T. E. Cowell. Both of Muscatine. Supt. J. J. Wall.

WEBSTER CITY, *Hamilton Co.* (Pop., 1,848; est., 3,200.) On Boon river, in coal region. Incorp. Has sewers. No electric lights.

History.—Built in '83 by village. Des. Engr., W. H. Burnham.

Water Supply.—Artesian well, pumping to tank and direct. Water was formerly taken from well 8 ft. diam., 40 ft. deep.

Pumping Machinery.—Dy. cap., 200,000 galls.; double-acting, 5 x 18-in. force pump, driven by 25-ft. windmill, both furnished by U. S. Wind Engine & Pump Co. In calm weather, and in case of fire, Knowles steam pump is used with 14 x 12-in. steam, 7-in. water cylinders.

Tank.—Cap., 58,000 galls.; 20 x 30 ft.; wooden, on 30-ft. timber trestle, 70 ft. above business part of town.

Distribution.—*Mains*, c. i. 1½ miles. *Services*, w. i. *Taps*, 100. *Meters*, none. *Hydrants*, Bailey, 15.

Consumption, 75,000 galls. *Pressure:* Ordinary, 20 lbs. Fire, 125 lbs.

Financial.—Cost, $21,000. Bonded debt, $13,000. Int., 6%. Sinking fund, $1,000. Ann. op. exp., $1,200. Ann. rev.: consumers, $1,000.

Management.—Comrs. Supt., S. E. La Barr.

WEST BURLINGTON, *Des Moines Co.* (Pop., est., 2,100.) Sewers projected in '89. No electric lights.

History.—Built in '87-8 by village for fire protection. Engr., B. C. Pennington, West Burlington. Contrs., Jno. Hult, Burlington, and F. L. Delfur, Carman, Ill. **Water Supply.**—Reservoir of C., B. & Q. R. R., pumping to tank. Water passes through meter. **Pumping Machinery and Tank.**—No data. **Distribution.**—*Mains*, 6-in. c. i., ¼ mile. *Taps*, not given. *Meters*, 1. *Hydrants*, Holly, 8. **Financial.**—Cost, $4,000. Bonded debt, $4,000. **Management.**—City Clerk, W. W. Clark. Supt., J. Kastlin.

WEST LIBERTY, *Muscatine Co.* (Pop., 1,141; est., 1,200.) Manufactures carriages, brick and tile. Incorp. No sewers or electric lights.

History.—Built in '87-9 by town. Contr., A. K. Wellen, Morris, Ill.

Water Supply.—Artesian well, by gravity. Well is 1,768 ft. deep at 30 ft. above business portion of town, and at sufficient elevation to supply most of residences without pumping. Dy. yield in '89, about 170,000 galls.

Distribution.—*Mains*, 6-in. c. i., 1¾ miles. *Taps*, 86. *Meters*, none.

Consumption and *Pressure*, unknown.

Financial.—Cost, $10,000. Debt, $10,000. Int., 6%. No. op. exp. Ann. rev.: consumers, $700.

Management.—Secy., F. K. Chase. Supt., A. H. McClure.

Water-Works Projected With Fair Prospects of Construction.

ALGORA, *Kossuth Co.* (Pop., 1,359; est., 2,500.) On Des Moines river. Engaged in manufacturing. Incorp. city of second class.

Proposed Works.—City drilling artesian well in '90, from which it may pump to stand-pipe. Mayor, J. R. Jones. Sec., W. B. Quarton. Report, Feb. 8, '90.

COON RAPIDS, *Carroll Co.* (Pop., est., 900.)

Proposed Works.—Address S. D. Henry.

EMMETTSBURGH, *Palo Alto Co.* (Pop., 879; est., 2,000.) On Des Moines river.

Proposed Works.—Aug., '89. Council had adopted plans and specifications for works to be owned by village. Supply, well, pumping to stand-pipe. Est. cost, $9,000 to be met by bonds. Unofficially reported in Sept., '89, that contract for artesian well had been let and that bids for complete works would soon be invited. Recorder, J. C. Young.

FAYETTE, *Fayette Co.* (Pop., 995.) On Volga river.

Proposed Works.—Electors were to vote on question of works March 3. No later data. Recorder, J. E. Fowells. Report, Feb. 6, '90.

GLENWOOD, *Mills Co.* (Pop., 1,793; est., 2,500.) Is 20 miles from Council Bluffs. Has manufactories.

Proposed Works.—Feb., '90, city had well down 1,390 ft., with water 40 ft. below surface. It was to be sunk deeper, in hopes to secure flow. Contrs., American Well Works Co., Aurora, Ill. Definite decisions as to complete works were not to be decided prior to April elections. See MANUAL for '88, p. 420. Report by Seth Dean.

GUTHRIE CENTRE, *Guthrie Co.* (Pop., 571; est., 1,000.)

Proposed Works.—Village may build in '90. Supply, well, pumping to tank, 172 ft. above well. Est. cost, $9,000; to be met by bonds, not yet sold. Address Chas. Ashton. Latest report, Mar. 8, '90.

HULL, *Sioux Co.* (Pop., est., 800.) Has lumber interests.

Proposed Works.—To be built by city in '90. Contr. for well, Artesian Well Drilling Co., St. Paul, Minn. Supply, well, (probably) by pumping. Est. cost, $3,000 to $6,000. Address City Council. Report, Jan. 22, '90.

JEFFERSON, *Greene Co.* (Pop., 1,444; est., 2,000.) Manufactures cigars and flour.

Proposed Works.—Artesian well drilled in, or prior to, '89; 2,020 ft. deep, water within 15 ft. of surface; 25-hours test with 5-in. pump showed yield of about 100 galls. per minute. Cost, $5,000; met by 5%, 10-year bonds. Feb. 7, '90, putting in distribution was under discussion, but it was thought works would not be built in '90. Mayor, Mahlon Head. Town Recorder, E. S. Young.

MANCHESTER, *Delaware Co.* (Pop., 2,275; est., 2,900.) On Maquoketa river. Has manufactories.

Proposed Works.—Town voted to build in '89, and appointed Com. to investigate. Chm., J. F. Merry. City Clerk, C. H. Day. Report Feb. 6, '90.

NEW HAMPTON, *Chickasaw Co.* (Pop., 1,105; est., 1,700.)

Proposed Works.—Spring of '89 proposition to bond town for works was defeated. Attempt to be made to induce private Co. to build. Address L. L. Briggs. Report, about Oct. 10, '89.

SIBLEY, *Osceola Co.* (Pop., 301; est., 1,600.)

Proposed Works.—Test well successfully sunk. Nothing definitely decided Feb. 7, '90. If built, water will be pumped to stand-pipe. Est. cost, $6,000 to $8,000. Report by M. J. Campbell.

Water-Works Projects Reported in '89 and 90, but now Indefinite.

Ackley, Hardin Co. *Centreville*, Appanoose Co. *Chester*, Howard Co. *Creston*, Union Co.; see MANUAL for '88, p. 420. *Dawson*, Dallas Co. *Grand Junction*, Greene Co. *Iowa Falls*, Hardin Co. *Kingsley*, Plymouth Co. *Onawa*, Monona Co. *Osceola*, Clarke Co.; see MANUAL for '88, p. 420. *Storm Lake*, Buena Vista Co. *What Cheer*, Keokuk Co. *Wilton Junction*, Muscatine Co.; see MANUAL for '88, p. 420.

MINNESOTA.

Water-Works Completed or in Process of Construction.

ALEXANDRIA, *Douglas Co.* (Pop., 1,335; est., 2,500.) No sewers. Has electric lights.

History.—Built in '89 by city; put in operation Dec. 15. Des. Engr., F. H. Todd, St. Cloud. Contrs., E. T. Sykes & Co., Minneapolis. Operated in connection with electric lights.

Water Supply.—Thirty 2½-in. driven wells, pumping direct at present.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Worthington comp. Steam from boilers of electric lighting plant.

Distribution.—*Mains*, 10 to 4-in. c. I., 2 miles; from Shickle, Harrison & Howard Co., St. Louis, Mo. *Hydrants*, Holyoke, 20. *Valves*, Crane.

Pressure: Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—Cost, est., $15,000. Debt, withheld. Int., 7%.

Management.—No data. Report by F. P. Clough, Minneapolis; date, Dec. 3, '89.

ANOKA, *Anoka Co.* (Pop., 2,706; est., 6,000.) On Mississippi river, at mouth of Rum river, 15 miles above Minneapolis. Has water-power and various manufactories. Incorp. city. No sewers. Has electric lights.

History.—Built in '89 by Anoka Water-Works & Electric Light Co. under 30-years franchise; put in operation Jan. 1, '90. Des. Engr., G. M. Beach. Contrs., E. T. Sykes & Co., all of Minneapolis.

Water Supply.—Rum river, pumping direct.

Pumping Machinery.—Dy. cap., 1,750,000 galls.

Distribution.—*Mains*, 12 and 6-in., 7 miles. *Hydrants*, 54.

Pressure: Ordinary, 80 lbs. Fire, 140 lbs.

Financial.—Cost, $65,000. Bonded debt, $65,000. Hydrant rental, $64.

Management.—Prest., E. T. Sykes, Minneapolis. Secy., F. Chase. Supt., E. Whitney. Report, Mar. 5, '90.

AUSTIN, *Mower Co.* (Pop., 2,305; est., 4,500.) On Cedar river. Has machine shops and canning factory. Incorp. No sewers. Has electric lights.

History.—Built in '87, put in operation Jan., '88, by town. Engr., Chas. F. Loweth, St. Paul. Contrs., National Iron & Brass Works, Dubuque, Ia.

Water Supply.—Artesian well for domestic, Cedar river for fire purposes, direct pumping.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two 1,000,000 Smedley, comp., cond.

Distribution.—*Mains*, 10 to 4-in. c. i., 4½ miles. *Services*, lead. Pipe from Detroit (Mich.) Pipe Works and Lake Shore Foundry, Cleveland, O. *Taps*, 72. *Meters*, none. *Hydrants*, Mathews, 52. *Valves*, Galvin.

Consumption, 60,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 80 lbs.

Financial.—Cost, $40,000. Bonded debt, $30,000. Int., 6 and 7%. Ann. op. exp., $2,500. Ann. rev.: consumers, $552.

Management.—Secy., Jno. Wold. Supt., J. M. Greenman.

BRAINERD, *Crow Wing Co.* (Pop., 2,319; est., 10,000.) On Mississippi river. Engaged in manufacturing and commerce. Incorp. Has sewers and electric lights.

History.—Built in '83 by Brainerd Water Co.

Water Supply.—Mississippi river, direct pumping.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; Blake, dup. cond., with 18 x 12-in. steam, 10-in. water cylinders.

Distribution.—*Mains*, c. i., kal. i., 14 miles. *Services*, galv. i. *Taps*, 700. *Meters*, not given. *Hydrants*, Ludlow, 75. *Valves*, Ludlow.

Consumption, 600,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 90 lbs.

Financial.—(In '87.) Cost, $110,000. Debt, $100,000. Int., 6%. Ann. op. exp., $7,900. Ann. rev.: consumers $8,000; city, $5,070. Hydrant rental, $75.

Management.—Prest., C. F. Kindred. Secy. and Treas., H. D. Powers.

CANNON FALLS, *Goodhue Co.* (Pop., 942; est., 1,200.) On Cannon river, which affords water-power used in manufacturing. Incorp. village. No sewers or electric lights.

History.—Built in '87-8 by village. Des. Engr., J. W. Potter. Const. Engr., Gus Oberg

Water Supply.—Well, pumping to reservoir.

Pumping Machinery.—A small pump made by H. Chalgreen, Cannon Falls, and driven by windmill.

Reservoir.—Cap., 175,000 galls.; 22 x 55 ft., x 12 ft. deep; 152 ft. above town.

Distribution.—*Mains*, 8-in. c. i., 1,500 ft. Pipe and specials from St. Louis (Mo.) Pipe Co.; trenching and pipe-laying done by C. L. Horn & Co. *Taps*, 15. *Meters*, none. *Hydrants*, Galvin, 2.

Pressure, 75 lbs.

Financial.—Cost, $5,500. Bonded debt, $5,000. Int., 6%. Ann. op. exp., withheld, est., $300. Ann. rev.: total, withheld, est., $300.

Management.—Village Council. Prest., D. E. Yale. Secy., J. A. Wilson.

CLOQUET, *Carlton Co.* (Pop., est., 3,000.) Has water-power. Incorp. village. No sewers or electric lights.

History.—Built in '86 by Cloquet Water Co., for domestic supply only.

Water Supply.—Source not given, pumping to tank.

Pumping Machinery.—No data.

Tank.—Cap., 16,000 galls.

Distribution.—Not given.

Financial.—Cost, $1,000. Cap. stock, authorized, $7,500. Other data withheld.

Management.—Prest., F. P. Thompson. Secy., H. B. Allen. Treas., A. Cox. Supt., A. W. McDowell.

NOTE.—Good fire protection furnished from Lumber Co.'s mills, through mains.

CROOKSTON, *Polk Co.* (Pop., 1,227; est., 6,000.) On Red Lake river, on rolling land, in lumber region. Settled in '72; incorp. city in '79. Has electric lights.

History.—Built in '82 by Crookston Water-Works, Power & Light Co., under 30-years franchise. Const. Engr., W. D. Hurlburt. Des. Engr. of later work, K. D. Chase, with D. Jacobus as Const. Engr. Labor done by Co.

Water Supply.—Red Lake river, by direct pumping. River rises 75 miles east of city, in Red lake; drainage area, 52¾ sq. m.

Dam.—Across river, size not given. Piles were driven in river, which has blue clay bottom, and filled between with brush, boulders, gravel and earth; piles capped and planked over.

Pumping Machinery.—Dy. cap., 2,500,000 galls.; 1,250,000 Worthington, also water-power pump designed by Jas. Waters, and built by Fray Mfg. Co.

Distribution.—(In '87.) *Mains*, c. i., 6½ miles. *Services*, w. i., lead. *Taps*, 125. *Meters*, 1. *Hydrants*, Ludlow, 41. *Valves*, Ludlow.

Consumption, 500,000 galls. *Pressure:* Ordinary, 65 lbs. Fire, 100 lbs.

Financial.—(In '87.) Cost, $150,000. Bonded debt, $105,000. Int., 7%. Ann. op. exp., $2,000. Ann. rev.: consumers, $9,000; city, $4,000. Hydrant rental, $100.

Management.—(In '88.) Prest., D. Jacobus. Treas., W. N. Ross. Secy., A. B. Goryas. Supt., D. Jacobus.

NOTE.—No report for '89 could be received.

DULUTH, *St. Louis Co.* (Pop., 3,483; est., 35,000.) At head of Lake Superior and at mouth of St. Louis river, on undulating ground. Engaged in commerce, lumbering, mining and manufacturing. Settled in '69; incorp. city in '87. Has sewers and electric lights.

History.—Built in '83 by Duluth Gas & Water Co., under 30-years franchise. Des. Engr., Carroll E. Gray. Const. Engr., R. P. Corbyn. Later work has been done with R. B. C. Bement as Des., and Wm. Craig, Const. Engr. H. H. Harrison, Stillwater, has been employed as Consult. Engr.

Water Supply.—Lake Superior, pumping to reservoir.

Intake.—Pipe was first laid into lake in trunk or box, sunk in granite bottom, pipe ending at crib in 40 ft. of water. Pipe was extended in '88.

Pumping Machinery.—Dy. cap., 5,000,000 galls.; 2,000,000 Blake, 3,000,000 Worthington, comp., dup. *Boilers:* tubular.

Reservoirs.—Cap., about 4,100,000 galls. *Old:* cap., 600,000 gals.; 40 x 80 ft., x 20 ft. deep; 265 ft. above pumps; granite masonry, with inner walls vertical. Enclosed to make it frost-proof.

New reservoir: cap., 3,500,000 galls., 275 ft. above pumps. Completed in '89.

Distribution.—*Mains*, c. i., w. i., kal. i., 25 miles. *Services*, lead. *Taps*, 950. *Meters*, 82. *Hydrants*, Ludlow, 148. *Valves*, Ludlow.

Consumption, 1,000,000 galls. *Pressure*, 20 to 90 lbs.

Financial.—Cost (May, '89), $732,430 Cap. stock, $500,000. Debt, $426,000: $337,000 at 6, $39,000 at 5%. Ann. op. exp., $39 005. Ann. rev.: consumers, $39.003; city, $16,161. Hydrant rental, $100 for 70, $80 for next 50, $60 for additional.

Management.—Prest., A. L. Belnap, N. Y. City. Secy., Geo. C. Squires. Treas., R. B. C. Bement, both of St. Paul. Supt., Wm. Craig.

ELY, *St. Louis Co.* (Pop., est., 1,200.) Has mining industries.

General Description.—Built in '89 by village, probably for fire protection only. Contrs., Marshall & Scott. Supply, creek, pumping to reservoir. Pump, No. 9 Knowles. Reservoir, 14 x 18 ft., x 18 ft. deep. *Mains*, 5-in., 2,000 ft. *Hydrants*, 6. Cost, $4,000. Supt., J. A. Cleveland. Report, about Sept. 10, '90.

FARIBAULT, *Rice Co.* (Pop., 5,415; est., 7,000.) At junction of Cannon and Straight rivers, on low ground with hills rising from valley from 100 to 200 ft. Settled in '53; incorp. city in '56. No sewers. Has electric lights.

History.—Built in '83-4 by Faribault Water-Works Co., under a 25-years franchise. Engrs., G. E. Beach and A. C. Miller. Contrs., Northwestern Water & Gas Supply Co. All of Minneapolis.

Water Supply.—Surface wells, pumping to reservoir. First well is 20 ft. diam. x 19 ft. deep, sunk through gravel to sandstone. Second well was sunk later, and is 30 ft. diam.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Deane, high and low-pressure, dup., cond. *Boilers:* tubular.

Reservoir.—Cap., 750,000 galls.: 80 ft. diam. x 23 ft. deep; roofed; 219 ft. above city and 235 ft. above pumps.

Distribution.—(In '87.) *Mains*, c. i., 7 miles. *Services*, w. i., lead. *Taps*, 106. *Meters*, 8. *Hydrants*, Chapman, 59. *Valves*, Chapman.

Consumption (in '87), 100,855 galls. *Pressure*, 96 lbs.

Financial.—(In '87.) Cost, $140,000. Debt, $80,000. Int., 6%. Ann. op. exp., $2,800. Ann. rev.: consumers, $3,000; city, $5,010. Hydrant rental, $80.

Management.—Prest., A. T. Rand, Secy., W. H. Getchell, 317 11th ave., South Minneapolis. Supt., A. C. Miller.

FERGUS FALLS, *Otter Tail Co.* (Pop., 1,634; est., 5,000.) On rolling prairie land, on Red river of the North, which falls 200 ft. in 4 miles, furnishing water-power used in manufacturing. Settled in '70; incorp. city in '81. Has sewers and electric lights.

History.—Built in '83 by Fergus Falls Water Co., under a 30-years franchise. Engr. and Contrs., Carroll E. Gray, Chicago, Ill.

Water Supply.—Red river of the North, direct pumping.

Dams.—Size not given: timber and stone, built across river two miles above main portion of city, originally for motive power only. Co. purchased either whole or partial water rights, and used dam and reservoir for power and storage.

Conduit.—Diam., 8 ft.; conveys water from dam to pumps under 12-ft. head.

Pumping Machinery.—Dy. cap., 4,250,000 galls.; two 1,500,000 dup., water-power, one 1,250,000 Worthington, steam.

Distribution.—*Mains*, kal. i., 8 miles. *Services*, lead, kal. i. *Taps*, 327. *Meters*, 1. *Hydrants*, Ludlow, 52. *Valves*, Ludlow.

Consumption, not known. *Pressure:* Ordinary, 55 lbs. Fire, 100 lbs.

Financial.—Cost, $168,000. Cap., stock, $82,000. Bonded debt, $88,000. Int., 6%. Sinking fund, $3,016. Ann. op. exp., $583 Ann. rev.: consumers, $7,450; city, $6,000. Hydrant rental, $80 for 50, $70 for additional.

Management.—Prest., C. E Gray, Chicago, Ill. Secy., F. W. Burnham. Treas., C. D. Wright. Supt., O. Moore.

FORT SNELLING, *Hennepin Co.* (Pop., est., 350.) On and about 100 ft. above Mississippi river. Established as military post by U. S. Government in '20.

History.—Built in '82 by U. S. Government. Des. Engr., Capt. Edw. Maguire, U. S. Corps of Engrs.

Water Supply.—Spring, pumping to tank and direct.

Dam.—Stone, 5 ft. high, 2½ ft. thick, coated on both sides with Weem's patent stone. Impounds spring water.

Pumping Management.—Dy. cap., 864,000 galls.; Blake, with 16 x16-in. steam, 8-in. water cylinders.

Tank.—Cap , 30,000 galls.; 56 ft. above pump.

Distribution.—*Mains*, c. i. 2 miles. *Services*, lead. *Taps*, 36. *Meters*, none. *Hydrants*, Mathews, 20. *Valves*, Chapman.

Consumption, 40,000 galls. *Pressure:* Ordinary, 25 lbs.

Financial.—Cost, $32,000. Ann. op. exp., $3,180. No debt or rev.

Management.—Post Quartermaster.

GLENWOOD, *Pope Co.* (Pop., 464; est., 500.) On Lake Whipple. Incorp. Has no sewers or electric lights.

History.—Built in '83 by village.

Water Supply.—Spring creek, by gravity from impounding reservoir.

Dam and Reservoir.—Cap., 150,000 galls.; about 40 x 100 ft., x 10 ft. deep. Dam consists of wooden cribs filled with stone, planked on upper side and backed with earth.

Distribution.—*Mains*, w. i., 1½ miles. *Services*, galv. i. *Taps*, 43. *Meters*, none. *Hydrants*, Ludlow, 8.

Consumption, not given. *Pressure*, 60 lbs.

Financial.—Cost, $8,000. Debt, $4,000. Int., 10%. Ann. op. exp., $500. Ann. rev.: consumers, $300.

Management.—City Council. Treas., P. Peterson. Supt., C. S. Brown.

LANESBORO, *Fillmore Co.* (Pop., 1,032; est., 1,200.)

History.—Built in '85-6 by village, for fire protection. **Water Supply.**—Well 200 ft. deep, pumping to reservoir. **Pumping Machinery.**—Dy. cap., 35,000 galls ; driven by windmill. **Reservoir.**—Cap., 225,000 galls.; about 130 ft. above town. **Distribution.**—(In '87.) *Mains*, 8-in. c. i , ½ mile. *Hydrants*, 6. *Pressure*, 60 lbs. **Financial.**—(In '87.) Cost, $10,000. Bonded debt, $5,000. Int., 7%. Ann. op. exp., $200. No rev. **Management.**—(In '88.) Secy., Jno. Johnson. Chf. Fire Co., B. A. Man.

NOTE.—No report for '89 could be obtained.

LITTLE FALLS, *Morrison Co.* (Pop., 508; est., 3,000.) On Mississippi river. Has water-power. Electric lights being put in in '90.

History.—Construction was to begin April 20, '90, by Little Falls Electric and Water Co., to be completed July 1, '90. Engrs. and Contrs., Harrison & Hawley, St. Paul.

Water Supply.—Mississippi river, pumping direct.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; water-power. *Water-wheels:* two, having 350 H. P.; furnish power for pumping and for electric lighting plant.

Distribution.—*Mains*, 3 miles. *Hydrants*, 37.

Financial.—Cost, est., $45,000; $25,000 additional for electric lights.

Management.—Prest., S. Stoll. V. Prest., Jno. A. Bersley, St. Paul. Secy. and Treas., J. B. Hutchins. Report, April 15, '90.

MANKATO, *Blue Earth Co.* (Pop., 5,550; est., 10,000.) At junction of Minnesota and Blue Earth rivers. Business part of city is 30 ft. above river, and back of this bluffs rise. Has sewers and electric lights.

EARLY FIRE PROTECTION WORKS.

General Description.—Built in '79 by city. See full description in MANUAL for '88.

PRESENT WORKS.

History.—Built in '88-9 by city, utilizing most of original plant. Engr., Edw. Lilly, City Engr. In '89 $40,000 of bonds were voted for extensions.

Water Supply.—Two flowing artesian wells, pumping to reservoir. Dy. yield in '89, 1,500,000 galls.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; Gaskill comp., cond., fly-wheel. *Boilers:* two 80-H. P. Holly. It is not stated whether 1,500,000-gall. Blake at old fire protection station is still in use.

Reservoir.—Cap., 850,000 galls.; 80 ft. in diam., 19 ft. deep; 200 ft above pumps and town. Excavated in clay 13 ft., 6 ft. of embankment. Sides vertical, lined with stone masonry, 4 ft. thick at bottom, 3 at top. Bottom covered with 2 ft. of riprap and cem. Roofed, roof being supported in center by stone pier. *Pipes:* influent and effluent is same, 10 ins. in diam.; overflow, 10-in., extending vertically to top of reservoir, discharging into ravine. Engr., see History. Contr., Adam Jefferson, Mankato. Cost, $6,000.

Distribution.—*Mains*, c. i., 4 miles. *Taps*, 150. *Meters*, kind not given, 21. *Hydrants*, Mathews, 45.

Consumption, 250,000 galls. *Pressure*, 95 lbs.

Financial.—Cost, $45,000. Debt, not given. Ann. op. exp., $2,500. Ann. rev.: consumers, $1,000.

Management.—City Engr., E. Lilly.

MINNEAPOLIS, *Hennepin Co.* (Pop., 46,887; est., 160,000.) On Mississippi river at St. Anthony's Falls. Has extensive water-power. City is on broad, elevated plain. Settled in '49; incorp. city in '67. Has sewers and electric lights.

History.—Built in '67 by city. Engr., Jas. Waters, who was connected with works for several years. Site of pumping station was changed in '72, and works enlarged. In '88-9 extensive improvements were made, including new and large pumping plant.

Water Supply.—Mississippi river, direct pumping.

Pumping Machinery.—Dy. cap., 70,000,000 galls.; about 40,000,000 water-power (described in MANUAL for '88, p. 423), and two 15,000,000 Worthington high duty, completed in '89. *Boilers:* horizontal, tubular. First pump was 2,000,000 Holly rotary, which was used until present old station was established in '72.

New Force Main.—C. i., 36-in., 12,000 ft. long; from new pumps to city.

Submerged Pipe.—Across Minnesota river. In Spring of '80, flood washed sand from under pipe for 100 ft., causing pipe to pull apart, and cutting off water from east side for six weeks. At this time broken pipe was covered by a deposit of 7 ft. of mud. It was relaid on bed-rock.

Distribution.—*Mains*, c. i., 141 miles. *Services*, w. i. *Taps*, 10,000. *Meters*, 306. *Hydrants*, Mathews, Waters, Lowry flush, 1,900. *Valves*, Eddy.

Consumption, 20,000,000 galls. *Pressure*, 80 lbs.

Financial.—Cost, $2,200,000. Debt, $1,235,000. Int., 4%. Sinking fund, included in general city fund. Ann. op. exp., $75,000. Ann. rev.: consumers, $150,000.

Management.—Registrar, F. T. Moody. Supt., J. H. McConnell.

MOORHEAD, *Clay Co.* (Pop., 1,700; est., 2,500.) On Red river of the North. Incorp. city. Has sewers and electric lights.

History.—Built in '81 by village. Des. Engrs., C. B. Hough. No Const. Engr.

Water Supply.—Red river of the North, direct pumping. July 1, '89, artesian well was being sunk, and had reached depth of 1,658 ft.

Pumping Machinery—Dy. cap., 4,000,000 galls.; Blake.

Distribution.—*Mains*, 10 to 4-in., c. i., 6 miles. *Services*, w. i. *Taps*, 260. *Meters*, none. *Hydrants*, Ludlow, 75.

Consumption, 250,000 galls. *Pressure:* Ordinary, 30 lbs. Fire, 100 lbs.

Financial.—Cost, $100,000. Debt, $30,000. Int., 5%. Sinking fund, $10,000. Ann. op. exp., $4,000. Ann. rev.: consumers, $3,500.

Management.—Water Com. City Attorney, C. A. Nye.

NEW ULM, *Brown Co.* (Pop., 2,471; est., 4,000.) On Minnesota river. Has manufactories. Incorp. city. No sewers. Has electric lights.

History.—Built in '89-90 by city; to be in operation June 1. Engr., Geo. C. Morgan. Contrs., Fairbanks, Morse & Co. All of Chicago.

Water Supply.—Well, pumping to reservoir, thence pumping to tank.

Pumping Machinery.—Dy. cap., about 150,000 galls.; deep-well.

Reservoir.—Cap., 45,000 galls.

Tank.—Cap., 26,000 galls.; on tower 104 ft. high.

Distribution.—*Mains*, 8-in., 2,287 ft.

Financial.—Cost, $10,900. Bonded debt, $10,000.

Management.—City Clerk, Louis Schilling. Latest report, Jan. 27, '90.

NOTE.—Subject to correction, as works were not completed time of report.

NORTH SAINT PAUL, *Ramsey Co.* (Pop., est., 2,000.) Is 1¼ miles from city limits of St. Paul. Has manufactories. Incorp. village. No sewers or electric lights.

History.—Built in '89 by North St. Paul Water, Light & Power Co., put in operation in Sept. Des. Engr., Robert Bement. Contrs., E. W. Peet & Son. Const. Engrs. and Sub-contrs., R. Bement & Co. All of St. Paul.

Water Supply.—Silver lake and artesian wells, pumping direct from lake and reservoir, and pumping to stand-pipe.

Reservoir.—No data.

Pumping Machinery.—Dy. cap., 1,150,000 galls.; Smith & Vaile artesian well, two Blake, one a dup. *Boilers:* from Brownell & Co., Dayton, O.

Stand-Pipe.—Cap., 51,000 galls.; 16 x (about) 34 ft.; from Fairbanks, Morse & Co., Chicago.

Distribution.—*Mains*, 10 to 4-in. c. i., 2 1-7 miles; from So. St. Louis (Mo.) Foundry Co. *Taps*, 10. *Meters*, 1. *Hydrants*, Mathews, 20. *Valves*, Eddy.

Consumption, 3,000 galls. *Pressure:* Ordinary, 35 lbs. Fire, 100 lbs.

Financial.—Cost, $29,286. Cap. stock, authorized, $250,000. Bonds, authorized $25,000; issued, $15,000. Int., not given. Ann. op. exp., est., $1,350. Ann. rev.: city, $2,700. Hydrant rental, $135.

Management.—Prest., Walter Morton. Secy., Wm. H. Lightner. Both of St. Paul. Treas., F. Driscoll, Jr. Supt., H. F. Holmes.

PIPE STONE, *Pipe Stone Co.* (Pop., 222; est., 1,500.)

History.—Built in '88 by village. Engr., Edwin Smedley. Contrs., National Iron & Brass Works, Dubuque, Ia.

Water Supply.—Bored well, 6 ins. diam. x 200 ft. deep, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 45,000 galls.; deep-well pump, 3½ x 18-in., driven by 25-ft. Halliday windmill.

Stand-Pipe.—Cap., about 90,000 galls.; 12½ x 100 ft.; from Shickle, Harrison & Howard Iron Co., St. Louis, Mo.

Distribution.—*Mains*, 8 to 4-in. c. i., 3 miles. *Taps*, 50. *Meters*, 1. *Hydrants*, Chapman, 13.

Consumption, 5,000 galls. *Pressure*, 40 lbs.

Financial.—Cost, $25,000. Bonded debt, $20,000. Int., 6%. Ann. op. exp., $350. Ann. rev.: consumers (in '87), $500.

Management.—Secy., E. C. Smith. Supt., G. S. Redmon.

RED WING, *Goodhue Co.* (Pop., 5,876; est., 7,000.) On Mississippi river. Has manufactories. Incorp. Partially sewered. Has electric lights.

History. Built in '84 by city. Des. and Consult. Engr., H. H. Harrison, Stillwater. Const. Engr., G. E. Beach, Minneapolis. Contrs., Northwestern Water & Gas Supply Co., Minneapolis.

Water Supply.—Mississippi river, filtered, pumping to reservoir.

Filters and Conduit.—Water passes from river through two wells, in the first of which are screens and in the second sponges. A 14-in. conduit, 800 ft. long, extends from filters to pump-well.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Blake, dup., non-cond., of 20 x 24-in. steam, 18-in. water cylinders.

Reservoir.—Cap., 1,000,000 galls.; 18 x 400 ft., x 20 ft. deep; 235 ft. above pumps, 210 ft. above city; excavated in side of rock bluff, lined with brick in cem.

Distribution.—(In '87.) *Mains*, c. i., 7.2 miles. *Services*, kal. i. *Taps*, 145. *Meters*, 32. *Hydrants*, kind not given, 61.

Consumption, about 80,000 galls. *Pressure*, 108 lbs.

Financial.—(In '87.) Cost, about $82,000. Debt, $80,000. Int., 5%. Ann. op. exp., $1,386. Ann. rev.: consumers, $3,139.

Management.—Secy., S. J. Willard. Supt., W. I. Miller.

ROCHESTER, *Olmsted Co.* (Pop., 5,103; est., 7,500.) Has electric lights.

History.—Built in '87 by Rochester Water-Works Co., under 30-years franchise. Controlled by Moffett, Hodgkins & Clarke, Syracuse, N. Y., who were Engrs. and Contrs. Engr. for preliminary work, Robt. E. Williams, deceased. Supt. of Construction, Wm. Walter, Phœnix, N. Y.

Water Supply.—Springs, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; Worthington.

Stand-Pipe.—Cap., 225,000 galls.; 25 x 62 ft.; from Riter & Conley, Pittsburgh, Pa.

Distribution.—*Mains*, 11 to 4-in. c. i., 10 miles. *Services*, galv. i. *Taps*, 150. *Meters*, kind not given, 23. *Hydrants*, Ludlow, 139. *Valves*, Ludlow.

Consumption, 40,000 galls. *Pressure:* Ordinary, 79 lbs. Fire, 150 lbs.

Financial.—Cost, $150,000. Debt, $115,000. Int., 6%. Ann. op. exp., $2,000. Ann. rev.: consumers, $4,600; city, $4,536.

Management.—Prest., J. F. Moffett. Supt., C. W. Streator.

SAINT CLOUD, *Stearns Co.* (Pop., 2,162; est., 10,000.) On Mississippi river, in agricultural and lumber district. Incorp. Has sewers and electric lights.

History.—Built in '83 by city, bought in '87 by St. Cloud Water-Works Co. Engrs. for original works, Pike & Sturtevant. Contrs., V. D. Simar & Co. Important extensions were made in '88 with E. T. Abbott, Minneapolis, as Engr. Day labor was employed.

Water Supply.—Mississippi river, pumping to stand-pipe and direct.

Intake Pipe and Crib.—Pipe is 16 ins. in diam. and in '88 was extended 747 ft. and new crib built. This was done in March, when river was covered with 28 ins. of ice and water 10 ft. deep. Pipe for extension was w. i., in lengths of 28¾ ft., and was riveted on ice. Piles were driven along line of pipe, 25 ft. apart, and timbers spiked to them at right angles. Through latter 7-16-in. rods with 10-ft. thread at upper end were run down vertically and bent around pipe. There were 24 rods, and by turning each nut upward, pipe was lowered throughout its entire length; it now rests against up-stream side of piles, which have been sawed off close to upper side of pipe. Pipe was furnished by Peter Devlin & Sons, Chicago, Ill.

Intake crib was sunk in similar way. It rests on 9 piles, sawed off at bed of river. It is 6 ft. sq. x 4 ft. high, has floor composed of 5 layers of 2-in. plank, and sides formed by screens of ⅜-in. iron with 3-in. meshes; top is of 1 x 1½-in. iron, with 5-in. meshes, and is loaded with 80 cu. yds. of small stone.

Pump-Well.—Is 4 x 14 ft., x 5 ft. deep.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two 500,000 Gaskill, one 2,000,000 Deane.

Stand-Pipe.—Cap., 350,000 galls.; 25 x 100 ft.; from Shickle, Harrison & Howard Iron Co., St. Louis, Mo.

Distribution.—(Jan. 1, '90.) *Mains*, c. i., 10¾ miles. *Services*, w. i. Pipe and specials from Shickle, Harrison & Howard Iron Co. *Taps*, 140. *Meters*, 11. *Hydrants*, Coffin, 106. *Valves*, Coffin.

Consumption, 350,000 galls. *Pressure:* Ordinary, 50 lbs Fire, 110 lbs.

Financial.—Cost (in '87), $175,000. Cap. stock, $150,000. Bonded debt, $130,000. Int., 6%. Ann. op. exp., $2,600. Ann. rev.: consumers, $3,500; city, $6,300. Hydrant rental, $60 for 100, $50 for additional.

Management.—Prest., E. T. Sykes. Secy., J. A. Chase. Both of Minneapolis. Chief Engr., Theo. H. Weinhaus.

SAINT PAUL, *Ramsey Co.* (Pop., 41,473; est., 200,000.) On Mississippi river. Bottom lands submerged in extreme high water, are about ¾ miles wide. They end at bluff of limestone, underlaid with sandstone, which rises abruptly 100 ft. to ter race ½ mile wide. Back of latter is range of drift hills which rises 250 ft. above river. At eastern end of city, Phalen's creek enters river through ravine. Settled in '38; incorp. town in '49; city in '54. Has sewers and electric lights.

History.—Built in '70 by private Co., and bought by city since '82 for $510,000. Important extensions made in '88.

Water Supply.—Phalen, Vadnais, Pleasant and others of chain of lakes, by gravity, and by direct pumping for high service. There is chain of 19 lakes, connected by natural and artificial channels; 9 of these lakes, at least, are available for city's supply. They have combined area of 2,436 acres, and from 1 to 4 ft. of water can be drawn from them.

Old Conduit.—First supply was by gravity from Phalen's lake, two pipes extending 300 ft. into it to 15 ft. of water. From shore a 24-in. stoneware and 16-in. cem. pipe conveyed water for 7,000 ft., when they united in 16-in. w. i. and cem. pipe, 15,700 ft. long, leading to city.

Pumping Machinery.—(*For high service.*) Dy. cap., 6,000,000 galls.; two pumps, make not given.

Reservoir.—Cap., 16,000,000 galls.; 300x500 ft. at water line, 20 ft. deep. Built to equalize pressure, and for economy in pumping, inlet and outlet pipe being one and same, and water passing from pump to reservoir when consumption is less than pumpage, and from reservoir to city mains when pumpage is less than consumption.

Sides are straight and ends semicircular. Embankments are 90 ft. thick at base, with inner and outer slopes of 1½ to 1, and parapet 12 ft. wide. Basin is of concrete, and inner slopes are faced with granite. Inlet and outlet pipe is at bottom, 36 ins. diam.

Water for this reservoir originally comes from Lake Vadnais through 4-mile conduit which terminates in chamber at pumps.

Engrs., J. T. Fanning, Minneapolis, and H. H. Harrison, Stillwater. Const. Engr., J. B. Hawley, who is Engr. to Water Board. Contrs., McArthur Bros., St. Paul. Cost, about $150,000.

Submerged Pipe.—A 16-in. pipe was laid across river in '87. Contrs., McRitchie & Nichol, Chicago, Ill.

Distribution.—*Mains*, c. i., w. i. and cem., 131⅞ miles. *Services*, lead, w. i. and cem. Pipe from Am. W. Wks. and Gas Pipe Co., now Ferris & Halladay, Jersey City, N. J.; w. i. pipe, of late, from Shickle, Harrison & Howard Iron Co., St. Louis,

Mo. *Taps*, 7,235. *Meters*, 284. *Hydrants*, Mathews, Ludlow, Whittier, Galvin, Holly, 1,134. *Valves*, Eddy, Ludlow, Galvin, Whittier.

Consumption, 10,000,000 galls. *Pressure*, 45 lbs.

Financial.—Cost, $2,483,936. Bonded debt, $2,160,000: $1,150,000 at 5, $660,000 at 4½, $350,000 at 4%. City assumed 8% bonds of Water Co. to amount of $160,000 when it purchased works. Ann. op. exp., $23,800; ann. int., $100,280. Ann. rev.: consumers, $130,039; city, $45,000, being $400 for each mile of mains. Hydrant rental, $40.

Management.—Secy., Jno. Caulfield. Supt., Jno. B. Overton.

SAINT PETER, *Nicollet Co.* (Pop., 3,436; est., 4,500.) On Minnesota river. Engaged in manufacturing. Incorp. city. No sewers or elcetric lights.

History.—Built in '88-9 by city; put in operation in Feb. Engr., G. E. Beach, Minneapolis. Contrs., P. Durack & Co., St. Paul.

Water Supply.—Well near river, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 1,750,000 galls.; Smedley. *Boilers:* from A. McKennan, St. Paul.

Stand-Pipe.—Cap., 151,000 galls.; 20 x 60 ft.; from A. McKennan, St. Paul.

Distribution.—*Mains*, 12 to 4-in. c. i., 3 miles; from Shickle, Harrison & Howard, St. Louis, Mo. *Taps*, 15. *Hydrants*, Chapman, 35. *Valves*, Chapman.

Pressure: Stand-pipe, 85 lbs. Fire, 110 lbs.

Financial.—Cost, $40,000. Bonded debt, $32,000. Int., 6%.

Management.—City Engr., J. M. Peterson.

SANDSTONE, *Pine Co.* (Pop., est., 800.)

History.—Built in '88 by W. H. Grant, and afterwards incorp. as Sandstone Water Co.; completed Dec. 22. Engr., A. Armstrong, St. Paul.

Water Supply.—Five springs, [probably] by gravity to and from reservoir.

Conduit.—Springs to reservoir, 6,856 ft. long.

Reservoir.—Cap., est., 2,000,000 galls.; 160 ft. in diam., 17 ft. deep.

Distribution.—*Mains*, 3-in., 2.2 miles. *Hydrants*, 7.

Financial—Cost., $15,000.

Management.—Prest., W. H. Grant. Secy. and Treas., W. H. Grant, Jr. Report, Oct. 10, '89.

SAUK CENTRE, *Stearns Co.* (Pop., 1,201; est., 3,000.) On Sauk river, which affords water-power used in manufacturing. No sewers. Has electric lights.

History.—Built in '84 by private Co., which has since failed. Town and Co. are in litigation, and meanwhile town operates works. Engr., S. D. Savier.

Water Supply.—Sauk lake, by direct pumping.

Pumping Machinery.—Dy. cap., 400,000 galls.; Worthington, water-power.

Distribution.—*Mains*, w. i., 1½ miles. *Services*, galv. i. *Taps*, 75. *Meters*, none. *Hydrants*, kind not given, 15.

Consumption, 40,000 galls. *Pressure:* Ordinary, 50 lbs. Fire, 110 lbs.

Financial.—Cost, $14,500. Bonded debt, $14,000. Int., 7%. Ann. op. exp., $1,800. Ann. rev.: consumers, $1,600; city, $1,225. Hydrant rental, $75.

Management.—City Council. Secy., A. H. Pettet. Supt., L. E. Coe.

STILLWATER, *Washington Co.* (Pop., 9,055; est., 18,000.) At head of Lake St. Croix, on small plain surrounded with hills which rise to elevation of about 280 ft. above valley. Engaged in manufacturing. Settled in '42; incorp. city in '54. Has sewers and electric lights.

History.—Built in '80 by Stillwater Water Co., under 30-years franchise. Des. Engr. of pumping machinery, H. H. Harrison. Const. Engr., Walter H. Sears. Contrs. Fruin & Co., St. Louis, Mo.

Water Supply.—McKusick's lake, filtered, by gravity for low, and by pumping to tanks for high service. Lake is about one mile from and 150 ft. above city; area, 55 acres; depth, 6 to 10 ft.; drainage area, about 6 sq. m.

Filter.—Is 50 x 100 ft., x 10 ft. deep, with gravel and charcoal placed upon 2 x 4-in. plank on edge with spaces between. From filter proper water passes to clear water reservoir 100 x 200 ft., x 10 ft. deep, from which water passes directly to city and to pumps.

Pump-Well.—Is 8 x 12 ft., x 12 ft. deep.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two Blake, with 20 x 24-in. steam, 11-in. water cylinders.

Tanks.—Cap., 200,000 galls.; each, 30 x 20 ft.; located on hills in different parts of city; number not given.

Distribution.—*Mains*, c. i., 9 miles. *Services*, galv. i. *Taps*, 510. *Meters*, L. *Hydrants*, Ludlow, 88. *Valves*, Ludlow.

Consumption, 1,000,000 galls. *Pressure*, 60 to 90 lbs.

Financial.—Cost, $215,600. Bonded debt, $100,000. Int., 7%. Ann. op. exp., $3,450, Ann. rev.: consumers, $9,500; city, $7,250. Hydrant rental, $85.

Management.—Prest., E. W. Durant. Secy. and Supt., H. H. Harrison. Treas., R. S. Davis.

TWO HARBORS, *Lake Co.* (Pop., est., 1,200.) Is 27 miles from Duluth. Incorp. village. No sewers or electric lights.

History.—Built in latter part of '89 by village. Engr., W. W. Curtis, St. Paul. Contrs., Fairbanks, Morse & Co., Chicago.

Water Supply.—Lake Superior, pumping direct and to tank.

Suction Pipe.—W. i., diam. and length not given.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Smith & Vaile dup., high-pressure, 18 x 10 x 18 ins.

Tank.—Cap., 105,000 galls.; 30 x 20 ft.; on 80-ft. wood tower.

Distribution.—*Mains*, c. i., 1¾ miles; from Contrs.; laid by St. Jacques & Filiatrault, Two Harbors. *Services*, w. i. *Hydrants*, Mathews, 11.

Pressure: Ordinary, 50 lbs. Fire, 150 lbs.

Financial.—Cost, $20,000. Bonded debt, $20,000. Int., 6%.

Management.—Village Council. Report Mar. 3, '90.

WINONA, *Winona Co.* (Pop., 10,208; est., 25,000.) On Mississippi river, from 12 to 15 ft. above it, surrounded by bluffs. Has general manufactories and electric lights.

History.—Built in '76 by city. Des. Engr. and Contr., Geo. C. Morgan, Chicago.

Water Supply.—Two wells near Mississippi river, each 38 ft. diam., x 50 ft. deep, pumping to stand-pipe. Second well was sunk in '88. When works were built two wells, 10 and 16 ft. in diam., and one mile apart, were drawn upon, there being pump for each in mill.

Pumping Machinery.—Dy. cap., 4,500,000 galls.; two Worthington; 2,000,000 comp., cond., low-pressure, 2,500,000 comp., cond., high-pressure; latter is used only in case of fire or emergency. Small Blake and Knowles pumps formerly used.

Stand-Pipe.—Is 4 ft. in diam. and 225 ft. high.

Distribution.—(In '87.) *Mains*, c. i., 16 miles. *Services*, w. i., galv. i. Pipe and specials from Dennis Long & Co., Louisville, Ky. *Taps*, 1,000. *Meters*, none. *Hydrants*, kind not given, 175.

Consumption (in '87), 1,184,634 galls. *Pressure:* Ordinary, 40 lbs. Fire, 90 lbs.

Financial.—(In '87.) Cost, $200,000. Debt, $100,000. Int., 4½%. Ann. op. exp., $14,000. Ann. rev.: consumers, $8,000.

Management.—(In '88.) Comr., Jno. B. Fellows. Supt., B. V. Simpson.

Water-Works Projected with Fair Prospects of Construction.

ADRIAN, *Nobles Co.* (Pop., est., 1,000.)

Proposed Works.—Supply, well, pumping to tank. Est. cost, $5,000 to $7,000. Report, Jan. 7, '90.

ALBERT LEA, *Freeborn Co.* (Pop., 1,966; est., 4,000.) Has manufactories and electric lights.

Proposed Works.—About Mar. 1, '90, city granted franchise to E. T. Sykes & Co., Minneapolis; construction to be begun about May. Supply (probably), artesian wells. Est. cost, $25,000 to $40,000. Report by W. A. Morin; date, Mar. 11, '90.

BLUE EARTH CITY, *Faribault Co.* (Pop., 1,066; est., 1,800.) On Blue Earth river.

Proposed Works.—An 8-in. well, 1,240 ft. deep, with water 28 ft. below surface, was sunk in '89 by city. Pump and distribution desired, but no definite plans Mar. 4, '90. Address City Recorder.

CHATFIELD, *Fillmore Co.* (Pop., 1,166; est., 2,000.)

Proposed Works.—Town has well, reservoir and 200 ft. of pipe laid, but no pump. Expects to complete works in 90. Reservoir, 60 ft. in diam., 20 ft. deep, natural rock bottom; 12 ft. in excavation; has wall 3 ft. thick at bottom, 2 at top, carried 8 ft. above natural surface; on hill 150 ft. above. 1,500 feet from centre of town. Report by C. H. White; date, Feb. 8, '90.

HUTCHINSON, *McLeod Co.* (Pop., 1,368; est., 2,000.) Has manufactories.

Proposed Works.—Village has sunk 4-in. artesian well 204 ft. which discharges 130 galls. per minute; cost, $450. Mains will be laid from year to year "according to state of village treasury." Recorder, E. J. Stearns. Report, Mar. 14, '90.

LAKESIDE, (*Duluth P. O.*) *St. Louis Co.* (Pop., not given.) Suburb of Duluth. Electric lights projected.

Proposed Works.—Feb. 17, '90 village granted 30-years franchise to Lakeside Light and Water Co., franchise to be renewed for 20 years at expiration of time unless city buys works. Supply, Lake Superior, pumping direct. Pumps, two, with combined cap. of at least 750,000 galls. Mains, at least 2 miles. Hydrants, 12 per mile. Hydrant rental, $100 each for first 50, $80 for second, $60 for additional. Village Prest., Wm. C. Sargent. Recorder, Chas. F. West.

LITCHFIELD, *Meeker Co.* (Pop., 1,250; est., 3,000.) On Lake Ripley. Has woolen and flour mills.

Proposed Works.—City to build in '90. Engr., Geo. C. Morgan. Contrs., Fairbanks, Morse & Co. All Chicago. Supply, driven wells, pumping to reservoir. Est. cost, $25,000; bonds issued. Report by A. D. Ross; date, Jan. 7, '90

LUVERNE, *Rock Co.* (Pop., 679; est., 1,800.) Has manufactories

Proposed Works.—Under discussion. Supply, artesian wells, pumping to stand-pipe. Report by Fred N. Van Duzee; date, Jan. 13, '90.

OWATONNA, *Steele Co.* (Pop., 3,161; est., 4,000.) On Straight river.

Proposed Works.—City to build in '90. April 8, '90, bids were opened. Supply, artesian well, pumping to stand-pipe. Pump, 1,000,000-gall. comp. Stand-pipe, 15 x 100 ft. Est. cost, $40,000. Engr., W. W. Curtis, St. Paul. Mayor, E. M. Morehouse.

PLAINVIEW, *Wabasha Co.* (Pop., 668; est., 700.)

Proposed Works.—Small fire protection plant. Supply, artesian well, pumping to tank. Address J. P. Waste or C. D. Burchard. Latest report, about March 5, '90.

WEST DULUTH, *St. Louis Co.* (Pop., est., 3,000.)

Proposed Works.—Light & Water Co. to build in '90. Supply, Lake Superior, pumping to tank. Two miles of mains to be laid by Dec. 31, '90, and 5 miles within 2 years. Hydrant rental, $80 for 80, $75 for additional; to be reduced to $60 when pop. reaches 20,000. Latest data, about Apr. 1, '90.

Water-Works Projects Reported in '89 and '90, but Now Indefinite.

Excelsior, Hennepin Co. *Madelia*, Watonwan Co. *Marshall*, Lyon Co. *Ortonville*, Big Stone Co.: see MANUAL for '88, p. 427. *Windom*, Cottonwood Co.

KANSAS.

Water-Works Completed or in Process of Construction.

ABILENE, *Dickinson Co.* (Pop., 2,360; est., 8,000.) On Smoky Hill river, on level ground. Railway and manufacturing center. Settled in '68. No sewers. Has electric lights.

History.—Built in '82 by Abilene Water & Electric Light Co. Des. Engr., C. Orton.

Water Supply.—Well, 20 ft. in diam., 40 ft. deep, direct pumping.

Pumping Machinery.—Dy. cap., 1,250,000 galls.; Gaskill dup.

Distribution.—*Mains*, c. i., 10½ miles. *Services*, w. i., lead. *Taps*, 350. *Meters*, 14. *Hydrants*, Holly, 68. *Valves*, Holly.

Consumption, 800,000 galls. *Pressure:* Ordinary, 30 lbs. Fire, 80 lbs.

Financial.—Cost, $190,000. Cap. stock, $100,000. Bonded debt, $133,000. Int., 6%. Ann. op. exp., $2,000. Ann. rev.: consumers, $6,500; city, about $6,350. Hydrant rental, $100 for 50, $75 for additional.

Management.—Prest., J. E. Bonebrake. Secy. and Supt., R. M. White.

ANTHONY, *Harper Co.* (Pop., 345; est., 3,500.) Incorp. city of second class. No sewers or electric lights.

History.—Built in '87 or '88 by Anthony Improvement Co.

Water Supply.—Eighteen driven wells, adjacent to Bluff creek, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Worthington.

Stand-Pipe.—Cap., 150,000 galls.

Distribution.—*Mains*, 10 to 4-in., kind not given. 8¼ miles. *Services*, not given. *Taps*, 250. *Hydrants*, Ludlow, 65.

Consumption, 160,000 galls. *Pressure*, 140 lbs.

Financial.—Cost, not given. Cap. stock, $100,000. Bonds, $50,000. Ann. op. exp., $4,000. Ann. rev.: consumers, $4,500; city, $3,500.

Management.—Prest., C. C. Pomeroy. Secy. and Treas., Chas. E. Kimball, 3 Pine St., N. Y. City. Supt., S. A. Darrough.

ARGENTINE, *Wyandotte Co.* (Pop., est., 6,000.) Is 5 miles from Kansas City, Mo. Incorp. city of second class. No sewers. Has electric lights.

History.—Built in '89-90 by Argentine Water & Electric Works Co., under 20-years franchise; put in operation about Feb., '90. Des. Engrs., Nier, Hartford & Mitchell, Kansas City. Const. Engr., Jno. W. Nier, of above firm.

Water Supply.—Six 6-in. Wagner wells, pumping to tank.

Pumping Machinery.—Dy. cap., 2,800,000 galls.; two 1,400,000 Deane comp., dup., with independent condensers. *Boilers:* from Pond Engineering Co., St. Louis, Mo.

Tank.—Cap., 500,000 galls.; 46 x 40 ft.; steel; from J. Mathews, So. Bend, Ind.

Distribution.—*Mains*, 12 to 4-in. c. i., 4 miles; from Shickle, Harrison & Howard Iron Co., St. Louis, Mo.; laid by Walker & Jones, Kansas City. *Hydrants*, Mathews, 29. *Valves*, Eddy.

Pressure, 110 lbs.

Financial.—Cost, $75,000. Cap. stock, authorized, $150,000. Bonded debt, $75,000. Int., 6%. Hydrant rental, $98.

Management.—Prest., M. V. Ingram. Secy. and Treas., J. D. Cruise. Supt., Fred J. Payne.

ARKANSAS CITY, *Cowley Co.* (Pop., 1,012; est., 10,000.) At junction of Walnut and Arkansas rivers. Has water-power. Sewers built in '89. Has electric lights.

History.—Built in '86 by Arkansas City Water Co. Engr., J. B. Quigley, Sedalia, Mo., who owns 90% of stock.

Water Supply.—Arkansas river, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two Blake comp., dup. *Boilers:* two 60-H. P. steel.

Distribution.—*Mains*, c. i., 13 miles. *Services*, galv. i., lead. *Taps*, 500. *Meters*, 18. *Hydrants*, Chapman, Bourbon, 154.

Consumption, 225,000 galls. *Pressure:* Ordinary, 50 lbs. Fire, 80 lbs.

Financial.—Cost, $150,000. Cap. stock, $150,000. No debt. Ann. op. exp., est., $4,500. Ann. rev.: consumers, withheld, est., $10,000; city, $9,240. Hydrant rental, $60.

Management.—Prest., J. B. Quigley, St. Louis. Secy., L. P. Andrews. Treas. and Supt., M. L. Andrews.

ARMOURDALE, *Wyandotte Co.* See Kansas City, Mo.

ARMSTRONG, *Wyandotte Co.* See Kansas City, Mo.

ATCHISON, *Atchison Co.* (Pop., 15,105; est., 25,000.) On Missouri river in valley of White Clay creek. Elevation varies from 38 to 180 ft. above low water in river. Important railroad center, having manufactories. Settled in 54; incorp. city in '58. Has sewers and electric lights.

History.—Built in '80 by Atchison Water Co. Des. Engr., Thos. J. Whitman.

Water Supply.—Missouri river, pumping to reservoir.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two Cope & Maxwell upright, direct-acting, plunger, with 24x36-in. steam, 14-in. water cylinders. Pumps are about 16 ft. above low water, and river rises 27 ft.

Reservoir.—Cap., 4,000,000 galls.; in two divisions, one of which is used as settling basin. This basin is 50x145 ft. at bottom, 100x185 at top, 13 ft. deep, 224 ft. above pumps. Its bottoms and sides are puddled, then covered with 4 ins. of broken stone, then paved with brick on edge in cem. Bottom slopes toward center and south end, where 12-in. outlet pipe allows sediment to be discharged. When river is frozen water can be used without settling, but at other times it stands from 8 to 12

hours in settling, before being drawn to clear water basin, which is 75x160 ft. at bottom, 145x220 ft. at top, 20 ft. deep, and has its water-line 1 ft. lower than tha of other basin.

Supply Main.—From reservoir to city, 4,000 ft. of 12-in. c. i. pipe. It is not stated whether this is still in use.

Distribution.—*Mains*, c. i., 13 miles. *Services*, galv. i., lead. *Taps*, 830. *Meters*, 60. *Hydrants*, White, 84. *Valves*, Peet.

Consumption, 600,000 galls. *Pressure*, 70 lbs.

Financial.—All data withheld. *Estimates:* Cost, $200,000. Ann. op. exp., $7,000. Ann. rev.: total, est., $20,000.

Management.—Prest., Jno. R. Lionberger. Secy., Jno. D. Davis, St. Louis, Mo. Supt., E. S. Wills.

BELLEVILLE, *Republic Co.* (Pop., 238; est., 3,000.) Incorp. city of second class. No sewers of electric lights.

History.—Built in '89 by Belleville Water, Light & Power Co., under 20-years franchise, which is renewed if city does not purchase; put in operation Dec. 20, '89. Engr. and Contr., S. K. Felton, Omaha, Neb.

Water Supply.—Wells and impounding reservoir on creek, filtered. Pumping to tank and direct in case of fire.

Dam and Impounding Reservior.—Cap. not given; area, about 15 acres. Within city limits, in 30-acre plot of land owned by Co., upon which are also located wells, filter and pumping plant. Dam of earth, 22 ft. high, 135 ft. thick at bottom, 35 at top. *Spillway:* 12 ft. from top, controlled by gate.

Filter.—Gravity; 8 ft. sand, gravel and charcoal.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two 1,000,000 Knowles comp., dup. *Boilers:* from Pond Engineering Co., St. Louis, Mo.

Tank.—Cap., 66,000 galls.; from Fairbanks, Morse & Co. Chicago, Ill.

Distribution.—*Mains*, 10 to 4-in. c. i., 5½ miles; from So. St. Louis (Mo.) Foundry. *Services*, ¾-in. *Taps*, est., 200; increasing rapidly. *Meters*, none. *Hydrants*, Cupfler, 43. *Valves*, Ludlow.

Pressure: Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—Cost, $55,000. Cap. stock, authorized, $50,000; paid up, $25,000. Bonds authorized and issued, $35,000. Int., 6%. Ann. op. exp., est., $2,000. Ann. rev: consumers, est., $2,000; city, $3,440. Hydrant rental, $80.

Management.—Prest., Geo. W. Collins. Secy. and Treas., J. F. Statesman. Supt., W. E. Dailey. Report, Feb. 10, '90.

BELOIT, *Mitchell Co.* (Pop., 1,835; est., 3,000.) On Solomon river. Has water-power. Has sewers. No electric lights.

History.—Built in '87 by city, afterwards sold to E. E. Stevens & Co., Larned, for $27,000, granting him a 21-years franchise. Des. Engr., J. S. Simmons. Labor done by Co.

Water Supply.—Wells on bank of Solomon river, pumping to tank.

Pumping Machinery—Dy. cap., 1,750,000 galls.; 750,000 Worthington, 1,000,000 Smith & Vaile.

Tank.—Cap., 120,000 galls. Iron, 32 x 20 ft.; on 70 ft. masonry tower.

Distribution.—*Mains*, 10 to 4-in. c. i., 5½ miles. *Services*, w. i. Pine and specials from Shickle, Harrison & Howard, St. Louis, Mo. *Taps*, 120. *Meters*, 3. *Hydrants*, Nelson, 70. *Valves*, Peet.

Consumption, 70,000 galls. *Pressure*, not given.

Financial.—Cost, $54,000. Cap. stock, $100,000. Bonded debt, $54,000. Int., 6%. Ann. op. exp., est., $1,720. Ann. rev.: consumers, $2,040; city, $3,250. Hydrant rental, $17.

Management.—Prest. and Supt., E. E. Stevens, Larned. Sec. and Treas., W. S. Park.

BIRD CITY, *Cheyenne Co.* (Pop., est., 300.) Incorp. No sewers or electric lights.

History.—Built in '87-8 by village. Engr. and Contr., Jos. Burns, Lincoln, Neb.

Water Supply.—Four 3-in. tube wells, about 240 ft. deep, pumping to tank.

Pumping Machinery.—Dy. cap., about 600,000 galls.; four vertical pumps. *Boiler:* 20-H. P.

Tank.—Cap., about 35,000 galls.

Distribution.—*Mains*, 3 and 2-in. w. i., 1½ miles. *Services*, not given. *Taps* 25. *Meters*, none. *Hydrants*, kind not given, 4.

Financial.—Cost, $5,000. Bonded debt, $5,500. Int., 7%. Ann. op. exp $800. Ann. rev.: consumers, $450.

Management.—City Clerk, Chas. T. Macy.

BLUE RAPIDS, *Marshall Co.* (Pop., 829; est., 1,000.) On Blue river. Has flouring, woolen and gypsum mills, foundry and machine shops. Incorp. city. No sewers or electric lights.

OLD WORKS.

General Description.—Built prior to '89 by city. Supply, wells, by pumping. Holly rotary pump, ¾ miles mains, 5 Holly hydrants. Distribution incorporated in present works.

NEW WORKS.

History.—Built in '89-90 by city; put in operation about Feb. 15. Engr., W. Kiersted. Contrs., Central Water-Works Construction Co. Both of Kansas City, Mo.

Water Supply.—Wells, pumping to reservoir.

Pumping Machinery.—Dy. cap., 2,500,000 galls.; Deane.

Reservoir.—Cap., 200,000 galls.; 51 ft. in diam.

Distribution.—*Mains*, 6 and 4-in. iron, 2½ miles. *Hydrants*, Holly, Galvin, 17. *Valves*, Eddy.

Pressure: Ordinary, av., 80 lbs. Fire, av., 105 lbs.

Financial.—Cost, about $18,000, including old works. Bonded debt, $18,000: (probably) $6,000 at 6, $12,000 at 5%.

Management.—No data. Reports from E. M. Brice and T. E. Marcy. Dates, Jan. 6 and Feb. 1, '90.

BUNKER HILL, *Russell Co.* (Pop., 135; est., 400.)

History.—Built in '76 by Bunker Hill Water Co., under 20-years franchise; sold under mechanics' lien to J. B. Corbett and others, who sold works to city Aug. 22, '89. Contrs., N. O. Nelson Mfg. Co., St. Louis, Mo.

Water Supply.—Springs, pumping to tank and direct.

Pumping Machinery.—Dy. cap., 30,000 galls.; from — Hopkins, Dubuque, Ia.

Tank.—Cap., about 60,000 galls.; 23 x 16 ft.

Distribution.—(In '87.) *Mains*, 2½-in. w. i., 3.7 miles. *Services*, galv. i. *Taps*, 36. *Meters*, none. *Hydrants*, kind not given, 5.

Consumption (in '87), 20,000 galls. *Pressure*, 30 lbs.

Financial.—(In '87.) Cost, $15,000. Cap. stock, $10,000. Debt, $8,500. Int., 10%. Ann. op. exp., $1,080. Ann. rev.: consumers, $1,080; city, $420.

Management.—Supt., W. H. Biays.

BURLINGTON, *Coffey Co.* (Pop., 676; est., 4,000.) On Neosho river. Has water-power used in milling. Incorp. No sewers. Has electric lights.

History.—Built in '86-7 by Burlington Water-Works Co., under a 20-years franchise. Engrs., Galen W. Pearsons, Kansas City, Mo., and Jas. A. O'Neil.

Water Supply.—Neosho river, filtered, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; Deane.

Filter.—No data.

Stand-Pipe.—Cap., about 40,000 galls.; 8x120 ft., from Jno. O'Brien, St. Louis, Mo.

Distribution.—*Mains*, c. i., 6 miles. *Services*, galv. i., lead. *Taps* (in '87), 230. *Meters*, not given. *Hydrants*, Chapman, 70. *Valves*, Chapman.

Consumption, 500,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 100 lbs.

Financial.—Cost, withheld, est., $55,000. Debt, $50,000. Int., 6%. Ann. op. exp., withheld, est., $2,500. Ann. rev.: consumers, withheld, est., $5,000; city, $3,500. Hydrant rental, $50.

Management.—Prest., H. L. Jarboe. Secy. and Treas., C. H. Race.

CALDWELL, *Sumner Co.* (Pop., 1,005; est., 3,000.) Incorp. No sewers or electric lights.

History.—Built in '86 by Co., under 20-years franchise. Mortgage on works was foreclosed, and for some time they were in the hands of Receiver, S. H. Horner. In '89 Mr. Horner and Post, Martin & Co., 3 Wall St., N. Y. City, holders of bonds, reorganized Co., and extended works. Des. Engr., A. N. Jones. Const. Engr., J. Simmons. Contrs., Jones & Tiernan.

Water Supply.—Bluff creek, pumping from impounding reservoir to stand-pipe. Previous to '89 source of supply was Fall creek. Filter was projected in '89.

Dam and Reservoir.—Cap., est., 35,000,000 galls. Dam, 8 ft. high. Built in '89.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Worthington, comp. and high-pressure.

Stand-Pipe.—Cap., 220,000 galls.; 12 x 150 ft.; 1¾ miles from pump-house; bottom 30 ft. above town; from Palmer & Son, Kansas City, Mo.

Distribution.—(Oct. 1, '89.) *Mains*, 12 to 4-in., c. i., 6½ miles. Pipe and specials for extensions from Shickle, Harrison & Howard Iron Co., St. Louis, Mo. *Services*, w. i. *Taps*, 175. *Meters*, none. *Hydrants*, Eclipse, Ludlow, 55.

Consumption, 90,000 galls. *Pressure:* Ordinary, 70 lbs. Fire, 160 lbs.

Financial.—Cost (Oct. 1, '89), est., $65,000. Cap. stock (in '87), $100,000. Bonded debt, $50,000. Int., 6%. Ann. op. exp., $2,800. Ann. rev.: consumers, $3,500; city, $3,000. Hydrant rental, $50 for first 50, $100 for next 5, $50 for additional.

Management.—Prest., Chas. E. Kimball, 3 Pine St., N. Y. City. Supt., S. H. Horner.

CHERRY VALE, *Montgomery Co.* (Pop., 690; est., 3,500.) No sewers. Has electric lights.

History.—Built in '85 by Cherry Vale Water & Mfg. Co., under 21-years franchise. Co. furnishes power to run Kansas Electric Light Co.'s plant.

Water Supply.—Drum creek, pumping from impounding reservoir to stand-pipe.

Reservoir.—Formed by dam. No data

Pumping Machinery.—Dy. cap., 1,000,000 galls.; three Deane.

Stand-Pipe.—Cap , about 35,000 galls.; 8 x 100 ft.; from Palmer & Son, Kansas City, Mo.

Distribution.—*Mains*, c. i. (in '87), 8½ miles. *Services*, galv. i. Pipe and specials from Chattanooga (Tenn.) Foundry & Pipe Works. *Taps*, 200. *Meters*, none. *Hydrants*, Chapman, 45. *Valves*, Chapman.

Consumption, 75,000 galls. *Pressure:* Ordinary, 50 lbs. Fire, 70 lbs.

Financial.—Cost, $125,000. Cap. stock, $200,000. Bonded debt, $60,000. Int., 7%. Ann. op. exp., $1,900. Ann. rev.: consumers, $3,208; city, $2,700. Hydrant rental, $60 for first 45, $50 for additional.

Management.—Prest., J. A. Handley. Secy. and Treas., C. T. Ewing Thayer. Supt., E. K. Davis.

CLAY CENTRE, *Clay Co.* (Pop., 1,753; est., 8,000.) On Republican river. Incorp. No sewers. Has electric lights.

History.—Built by Clay Centre Water Co., under 20-years franchise. Engrs. and Contrs., Drake & Orton.

Water Supply.—Surface water, by direct pumping.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; 1,500,000 Gaskill dup.; other not given.

Distribution.—*Mains*, c. i., 5 miles. *Services*, galv. i., lead. *Taps*, 209. *Meters*, 1. *Hydrants*, Holly, 41.

Consumption, 20,000 galls. *Pressure:* Ordinary, 45 lbs. Fire, 160 lbs.

Financial.—Cost, $85,000. Cap. stock, $100,000. Bonded debt, $60,000. Int., 7%. Ann. op. exp., $2,500. Ann. rev.: consumers, $2,500; city, $1,000. Hydrant rental, $100 for first 50, $75 for additional.

Management.—Prest., A. A. Godard. Secy. and Treas., D. A. Valentine. Supt., J. A. Hanna.

CLYDE, *Cloud Co.* (Pop., 956; est., 1,700.) On Republican river. Incorp. No sewers. Has electric lights.

History.—Built in '87 by village Engr., J. W. Nier, now of Nier, Hartford & Mitchell, Kansas City, Mo.

Water Supply.—Steamed wells, pumping to stand-pipe.

Pumping Machinery.—Dy. cap , 150,000 galls.; two Deane comp., dup.

Stand-Pipe.—No data.

Distribution.—*Mains*, kind not given, 4 miles. *Services*, not given. *Taps*, 137. *Meters*, none. *Hydrants*, kind not given, 40.

Consumption, 80,000 galls. *Pressure*, not given.

Financial.—Cost, $30,000. Debt, not given. Int. 6%. Ann. op. exp., $1,240. Ann. rev.: consumers, $1,452.

Management.—Treas., F. A. Griffin. Supt., S. F. Robinson. Report by S. R. Kinch.

COLUMBUS, *Cherokee Co.* (Pop., 1,161; est., 2,300.) No sewers or electric lights.

History—Built in '87 by Long & Doubleday under 21-years franchise. Put in operation Dec. 26, '87. Engr., J. B. Johnson, St. Louis, Mo. No Contrs.

Water Supply.—Artesian well, pumping to stand-pipe and direct.

Pumping Machinery.—Dy. cap., 1,750,000 galls ; 750,000 Blake vertical, pumping to surface-basin, and 1,000,000 Buffalo, pumping to stand-pipe.

Stand-Pipe.—Cap., 97,000 galls.; 12½ x 150 ft.

Distribution.—*Mains*, kind not given, 4½ miles. *Services*, not given. *Taps*, 225. *Meters*, none. *Hydrants*, kind not given, 50.

Consumption, about 75,000 galls. *Pressure*, at pumps, 140 lbs.

Financial.—Cost, $60,000. Debt and int., not given. Ann. op. exp., withheld, est., $2,800. Ann. rev.: consumers, $2,000; city, $3,000. Hydrant rental, $50.

Management.—Prest. and Secy., R. A. Long. Treas., L. L. Doubleday. Supt., C. McNulty.

CONCORDIA, *Cloud Co.* (Pop., 1,853; est., 4,000.) In coal region: has stone quarries. No sewers. Has electric lights.

History.—Built in '87-8 by town. Des. Engr., Galen W. Pearsons, Kansas City, Mo. Const. Engrs., D. L. Gregg, Concordia, and L. D. May.

Water Supply.—Cook well system, near Platt river, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Deane.

Stand-Pipe.—Cap., 95,000 galls.; 15 x 75 ft.

Distribution.—*Mains*, c. i., 6 miles. *Services*, lead, iron. *Taps*, 155. *Meters*, kind not given, 1. *Hydrants*, Galvin, 52. *Valves*, Galvin.

Consumption, 120,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 100 lbs.

Financial.—Cost, $46,000. Debt, $45,000. Int., 5%. Ann. op. exp., $2,500. Ann. rev.: consumers, $1,000.

Management.—Water Comr., W. R. Harvey. Report by W. J. Cooper.

CONWAY SPRINGS, *Sumner Co.* (Pop., 258; est., 1,000.) Incorp. No sewers or electric lights.

History.—Built in '88 by Conway Springs Water Co.

Water Supply.—Well, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; make not given.

Stand-Pipe.—Cap., 17,000 galls.; 6 x 80 ft.

Distribution.—*Mains*, 2¼ miles. *Taps*, 27. *Hydrants*, 8.

Financial.—Cost, $12,000. No debt. Ann. op. exp., $700. Ann. rev.: consumers, $1,200.

Management.—Supt., G. W. Fahs.

COOLIDGE, *Hamilton Co.* (Pop., est., 1,500.) Incorp. city. No sewers or electric lights.

History.—Built in '88-9 by Peck Water-Works Co., under 50-years franchise. Put in operation Apr. 1, '89. Des. Engr., E. H. Peck, Coolidge. Const. Engr., Wm. Fankisley.

Water Supply.—Flowing artesian well, pumping from receiving reservoir direct and to stand-pipe. Well is tubed, 6 ins. in diam., 298½ ft. deep.

Receiving Reservoir.—Cap., 390,000 galls.

Pumping Machinery.—Dy. cap., 125,000 galls.; Hughes comp., dup. *Boiler:* Atlas.

Stand-Pipe.—Cap., 110,000 galls.

Distribution.—(June 1, '89.) *Mains*, kind not given. About 3 miles. *Services*, ¾-in. galv. i. Pipe and specials from Crane Mfg. Co. *Taps* and *Meters*, not determined. *Hydrants*, Eclipse, number not given.

Consumption, not determined. *Pressure:* Ordinary, 55 lbs. Fire, 160 lbs.

Financial.—Cost, $30,000. Cap. stock, $60,000. Debt, none. Ann. op. exp. and rev., not determined. Hydrant rental, $72.

Management.—Prest., E. N. Peck, Stamford, Conn. Supt., Secy. and Treas., E. H. Peck.

COUNCIL GROVE, *Morris Co.* (Pop., 1,041; est., 3,800.) No sewers. Has electric lights.

History.—Built in '87-8 by Council Grove Water Co., under 20-years franchise. Des. Engr., W. E. Allen, N. Y. City. No general Contrs.

Water Supply.—Well, near river, pumping to stand-pipe and direct.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; Davidson.

Stand-Pipe.—No data.

Distribution.—*Mains*, c. i., 4 miles. Pipe and specials from Shickle, Harrison & Howard Iron Co., St. Louis, Mo. *Services*, not given. *Taps*, 75. *Hydrants*, Ludlow, 37. *Valves*, Ludlow.

Consumption, 25,000 galls. *Pressure*, 60 lbs.

Financial.—Cost, withheld, est., $37,000. Cap. stock, debt and int., withheld. Ann. rev.: city, $2,560. Hydrant rental, $70 for first 35, $55 for additional.

Management.—Prest., Danl. Runkle. Secy. and Treas., W. E. Stiger. Both of N. Y. City. Supt., F. Armstrong.

CULLISON, *Pratt Co.* ((Pop., est., 500.) Incorp. No sewers or electric lights.

History.—Built in '88 by village and Wichita & Western R. R. Co , city owning distribution system, only. Des. Engr., F. Wm. Raeder, St. Louis, Mo. Contr., Guido Jaeger, Rich Hill, Mo.

Water Supply.—Well, pumping to tank. Well is 18 ft. in diam., 110 ft. deep.

Pumping Machinery.—Dy. cap., 144,000 galls.; Knowles.

Tank.—Cap., 54,000 galls.; 24 x 16 ft.; on 24-ft. tower.

Distribution.—*Mains*, c. i., 1½ miles. *Services*, w. i. *Taps*, 34. *Meters*, 1. *Hydrants*, kind not given, 8. *Valves*, Chapman.

Consumption, 1,725 galls. *Pressure:* Ordinary, 30 lbs. Fire, 90 lbs.

Financial.—Cost to city, $6,500. Debt, do., $6,500. Int., 7%. Ann. op. exp., $575. (See below.) Ann. rev.: consumers, $500. Hydrant rental, total of $500 for 12, $35 for each additional. City pays Co. 10 cents for 1,000 galls. for domestic consumption, and hydrant rental, as above.

Management.—*Pumping service:* Wichita & Western R. R Co. *Distribution:* Clerk, J. M. McLane. Collector, W. C. Gould.

DODGE CITY, *Ford Co.* (Pop., 996; est., 5,000.) On Arkansas river. Incorp. Has sewers and electric lights.

History.—Built in '86 or '87 by Dodge City Water Supply Co., under franchise granted June, '86.

Water Supply.—Source not given, pumping to tank.

Pumping Machinery.—Dy. cap., 750,000 galls.; Smith & Vaile.

Tank.—Cap., 80,000 galls.

Distribution.—*Mains*, kind not given, 5 miles. *Services*, not given. *Taps*, withheld, est., 100. *Meters*, not given. *Hydrants*, kind not given, 50.

Consumption, not given. *Pressure*, 130 lbs. at pumps.

Financial.—Cost, withheld, est., $50,000. Cap. stock, debt and int., withheld. Ann. op. exp., withheld, est., $2,500. Ann. rev.: consumers, withheld, est., $2,500, city, $2,500. Hydrant rental, $50.

Management.—Prest. and Treas., F. W. Gilbert. Secy., E. E. Soule. Supt. F. A. Heineke.

DOWNS, *Osborne Co.* (Pop., 456; est., 1,600.)

History.—Built in '88 by village. Des. Engr., Jno. W. Nier, Kansas City, Mo. Contr., E. Sutphin, St. Louis, Mo.

Water Supply.—Eight Wagner wells, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 100,000 galls.; Deane comp., dup.

Stand-Pipe.—Cap., 100,000 galls.

Distribution.—*Mains*, 6 and 4-in. i., 2.8 miles. *Services*, not given *Taps*, withheld, est., 40. *Meters*, not given. *Hydrants*, 20.

Consumption and *Pressure*, not given.

Financial.—Cost, $37,000. Bonded debt, $30,000, running 30 years. Int., 6%. Ann. op. exp. and rev., not determined

Management.—(In '88.) City Clerk, J. M. Bower. Supt., Jas. Turner.

EL DORADO, *Butler Co.* (Pop., 1,411; est., 6,000.) On Walnut river. Has electric lights.

History.—Built in '87 by El Dorado Water Supply Co.

Water Supply.—Well, pumping to stand pipe and direct.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; Blake.

Stand-Pipe.—Cap., 120,000 galls.; 12 x 150 ft.

Distribution.—*Mains*, c. i., 8 miles. *Services*, galv. i. *Taps*, 200. *Meters*, 6. *Hydrants*, Nelson, 67.

Financial.—Cost, est., $80,000. Cap. stock, $100,000. Bonded debt, $60,000. Int., 6%. Ann. rev.: consumers, $3,600; city, $3,350. Hydrant rental, $50.

Management.—Prest., J. F. Thompson. Secy., C. H. Baldwin. Treas. and Supt., C. L. Turner.

ELLSWORTH, *Ellsworth Co.* (Pop., 929; est., 2,500.) Incorp. No sewers. Has electric lights.

History.—Built in '86 by town. Engrs. and Contrs., Fairbanks, Morse & Co., Chicago, Ill.

Water Supply.—Driven wells, pumping to tank.

Pumping Machinery.—Dy. cap., 1,200,000 galls.; one Smith & Vaile and one Buffalo. *Boilers:* two, 2⅝ x 12 ft., steel.

Tank.—Cap., 100,000 galls.; from Contrs.

Distribution.—*Mains*, c. i., 7 miles. *Services*, w. i. *Taps*, 160. *Meters*, none. *Hydrants*, Eclipse, 62.

Consumption, 250,000 galls. *Pressure:* Ordinary, 55 lbs. Fire, 100 lbs.

Financial.—Cost, $50,000. Bonded debt, $50,000. Int., 6%. Ann. op. exp., $1,500. Ann. rev.: consumers, $1,200.

Management.—Secy., J. M. Champion. Supt., T. J. Noble.

EMPORIA, *Lyon Co.* (Pop., 4,631; est., 12,000.) Between Cottonwood and Neosho rivers. Engaged in manufacturing and trade. Settled in '57; incorp. city in 70. No sewers. Has electric lights.

History.—Built in '80-2 by city, and rebuilt in '87-8. Engrs. and Contrs. for original system, Holly Mfg. Co., Lockport, N. Y., and Russell & Alexander. Later Contrs. for reservoirs, trenching and pipe-laying, McRae & Lally, Detroit, Mich.

Water Supply.—Neosho river, pumping direct and to reservoir. First supply was from well on bank of Cottonwood river, 25 ft. in diam., 26 ft. deep.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; 1,000,000 Holly quadruplex, 2,000,000 Gaskill vertical; former was first in use, originally rated at 1,500,000 galls.

Reservoir.—Cap., 15,000,000 galls.; area, 4 acres; 20 ft. deep; two basins, of equal size. Built in gravelly clay; in building, every 6 ins. was sprinkled, then rolled by 2,000-lb. roller. Width of embankment on top, 12 ft., at bottom, 60 ft. Inner slope, 1½ to 1, paved with limestone blocks, 1 ft. wide, 1 ft. thick, 4 to 8 ins. long; outer, 2 to 1. Des. Engr., J. D. Cook, Toledo, O. Contrs., see History.

Distribution.—*Mains*, c. i., 22 miles. *Services*, galv. i. Pipe and specials for early work from Dennis Long & Co., Louisville, Ky.; for late work, from Shickle, Harrison & Howard Iron Co., St. Louis, Mo. *Taps*, 740. *Meters*, none. *Hydrants*, Holly, 123.

Consumption, 150,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 140 lbs.

Financial.—Cost, $255,000. Debt, $225,000. Int., 5%. Ann. op. exp., about $5,000. Ann. rev.: consumers, $7,000.

Management.—Water Com. Supt., R. W. Jeremy.

EUREKA, *Greenwood Co.* (Pop., 1,127; est., 5,000.) On Fall river. Incorp. No sewers or electric lights.

History.—Built in '88-9 by city. Des. Engr., Jas. W. Nier, Kansas City, Mo. Contrs., S. K. Felton & Co., Omaha, Neb.

Water Supply.—Fall river, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; two 500,000 Dean comp., dup. *Boilers:* from Joplin (Mo.) Machine Co.

Stand-Pipe.—Cap., 96,000 galls.; 18x30 ft., from Joplin (Mo.) Machine Co.

Distribution.—*Mains*, 10 to 4-in. c. i., 6 miles. *Services*, not given. Pipe and specials from Ripley & Bronson, St. Louis, Mo. *Taps*, 80. *Meters*, none *Hydrants*, Mathews, 33. *Valves*, Chapman.

Consumption, 96,000 galls. *Pressure*, 75 lbs.

Financial.—Cost, $50,000. Debt, $50,000: $10,000 at 7, $40,000 at 5%. Ann. op. exp., est., $800. Ann. rev.: consumers, est., $600.

Management.—Prest., H. L. Stoddard. Secy. and Supt., F. W. Watson.

FLORENCE, *Marion Co.* (Pop., 954; est., 2,300.) On Cotton and Doyle rivers. No sewers or electric lights.

History.—Built in '87-8 by Florence Water Supply Co. Des. Engr., J. W. Nier, Kansas City, Mo. Const. Engr., A. D. Hanck. Labor done by Co.

Water Supply.—Cotton river, pumping from filtering gallery to stand-pipe and direct.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; two Deane comp., dup.

Stand-Pipe.—Cap., 68,000 galls.; bottom is 80 ft. above city.

Distribution.—*Mains*, c. i., 3¼ miles. *Services*, not given. *Taps*, 26. *Meters*, not given. *Hydrants*, Holly, 25.

Consumption, 100,000 galls. *Pressure*, not given.

Financial.—Cost, $42,000. Cap. stock, $20,000. Bonded debt, $20,000. Int., 6%. Ann. op. exp., $1,200. Ann. rev.: consumers, $1,300; city, $1,200. Hydrant rental, $50.

Management.—Prest., J. W. Thurston. Secy., and Treas., J. N. Strickler. Topeka. Supt., A. F. Horner.

FORT RILEY, *Davis Co.* (Pop., est., 1,500.) Government military post. Has sewers. No electric lights.

History.—Built in '88 by U. S. Government. Des. Engr., J. B. Johnson, St. Louis, Mo. Plans were somewhat modified by Capt. Geo. E. Pond, Asst. Quartermaster, U. S. A. Const. Engr., W. H. Stair. Contrs., Jno. Dwyer & G. W. Pearsons, Kansas City, Mo.

Water Supply.—Wagner wells, near Republican river, pumping, through distribution, to reservoir. There are eight 6-in. wells from 50 to 65 ft. deep.

Pump-Well.—Is 18 x 26 ft., x 15 ft. deep.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Deane comp., dup., with 14 and 20-in. steam and 10¼-in. water cylinders of 18-in. stroke; 400,000 Deane, formerly used, has been repaired and is used as auxiliary. *Boilers:* two, 75-H. P., 5 x 15 ft.

Reservoir.—Cap., 500,000 galls.; about 300 ft. above buildings; stone, reinforced by earth embankments, covered with tin roof.

Distribution.—*Mains*, 8-in. c. i., 4.2 miles; from Chattanooga (Tenn.) Foundry and Pipe Works. *Services*, galv. i. *Taps*, 73. *Hydrants*, Beaumont, White, 28. *Valves*, Chapman.

Consumption, 125,000 galls. (1,200 horses are supplied.) *Pressure:* Ordinary, 60 lbs. Fire, 100 lbs.

Financial.—Cost, $45,189. No debt or rev.

Management.—Asst. Q. M., Geo. E. Pond.

FORT SCOTT, *Bourbon Co.* (Pop., 5,372; est., 20,000.) On Marmaton river. Engaged in manufacturing and coal mining. Incorp. town in '55. Partially sewered. Has electric lights.

History.—Built in '82 by Fort Scott Water Co., and reconstructed by them in '87. Des. Engr., S. H. Lockett. Contrs., Comegys & Lewis. Both of N. Y. City.

Water Supply.—Marmaton river, pumping from two impounding reservoirs to stand-pipe and reservoir.

Dams and Impounding Reservoirs.—Cap., 85,000,000 galls. Two dams form reservoirs on river. Both are of solid masonry. Lower dam is 125 ft. long, 12 ft. high, 8 ft. wide at bottom, 2 ft. wide at top. Presents smooth front with oak apron; bottom probably of concrete in kind of soap-stone. Upper dam is built in solid rock; is 150 ft. long, 8 ft. high, 8 ft. wide at bottom, 2 ft. wide at top; same style as lower dam. Leakage very slight.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; Worthington, formerly Perkins. *Boilers:* Brown.

Stand-Pipe.—Cap., 100,000 galls.; 14 x 80 ft.; ⅛ in. w. i.; on stone foundation 30 ft. high.

Distributing Reservoir.—Cap., 4,000,000 galls.

Distribution.—*Mains*, c. i., 23 miles. *Services*, galv. i. *Taps*, 875. *Meters*, 12. *Hydrants*, Chapman, 78. *Valves*, Chapman.

Consumption, 500,000 galls. *Pressure:* Ordinary, 25 lbs. Fire, 100 lbs.

Financial.—Cost, withheld, est., $250,000. Ann. op. exp., $4,200. Ann. rev.: consumers, about $14,000; city, about $3,400. Hydrant rental about $55 for 55, and $50 for additional.

Management.—Prest., Alger G. Black. Secy., J. W. Maguire. Both of N. Y. City. Treas. and Gen. Mgr., Geo. F. Wyman. Supt., R. S. Worthington.

FREDONIA, *Wilson Co.* (Pop., 923; est., 3,200.) On Fall river. No sewers. Has electric lights.

History.—Built in '87-8 by Jas. A. O'Neil, under name of Fredonia Water Co. Mr. O'Neil designed works and built them with days labor. Franchise will run 20 years unless city buys works.

Water Supply.—Wells near Fall river, 3 miles from city, pumping to reservoir. Connection is made with river, and direct pumping from either wells or river can be used.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two Deane; one comp. and one high-pressure. *Boilers:* two, steel, tubular, from Jno. O'Brien & Co., St. Louis, Mo.

Reservoir.—Cap., 3,000,000 galls.; on hill near, and 187 ft. above city. Three brick walls will be built across reservoir, between inlet and outlet, to serve as filters.

Distribution.—*Mains*, c. i., 7 miles. *Services*, galv. i., lead. Pipe and specials from Chattanooga (Tenn.) Foundry & Pipe Works. *Taps* (in '87), 208. *Meters*, none. *Hydrants*, Chapman, 50. *Valves*, Chapman.

Consumption, 230,000 galls. *Pressure:* Ordinary, 100 lbs. Fire, 175 lbs.

Financial.—Cost, $88,000. Debt, $75,000. Int., 6%. Ann. op. exp., $1,800. Ann. rev.: consumers, $6,300; city, $3,120. Hydrant rental, $60.

Management.—Prest., R. T. Race. Treas. and Supt., A. S. Race. Secy., B. B. Tuttle.

GALENA, *Cherokee Co.* (Pop., 1,463; est., 3,000.) Engaged in lead and zinc mining. Incorp. city of second class. No sewers or electric lights.

History.—Built in '89 by Galena Water Co., under 20-years franchise; put in operation Aug. 1. Engr. and Contr., A. H. McCormick, Parsons.

Water Supply.—Shoal river, pumping to stand-pipe and direct.

Pumping Machinery.—Dy. cap., 1,250,000 galls.; Smith & Vaile.

Stand-Pipe.—Cap., about 105,000 galls.; 12½ x 125 ft.; steel; from Jno. O'Brien Boiler Works Co., St. Louis, Mo.

Distribution.—*Mains*, 10 to 4-in. c. i., 5½ miles; from So. St. Louis (Mo.) Foundry Co.; laid by C. M. Davison, Pittsburgh, Kan. *Services*, galv. 1. *Taps*, est., 200. *Meters*, Crown, 2. *Hydrants*, White, 40. *Valves*, Peet.

Pressure, 90 lbs.

Financial.—Cost, $65,000 Cap. stock, $100,000. Bonded debt, $40,000. Int., 6%. Ann. op. exp., est., $800. Ann. rev.: consumers, "assured," $4,000; city, $2,500. Hydrant rental, $62.50.

Management.—Prest., E. H. Edwards, Parsons. Secy., W. B. Stone. Treas., J. R. Brown, Parsons. Report, July 16, '89.

CARDEN CITY, *Finney Co.* (Pop., est., 6,000.) On Arkansas river. Incorp. Has sewers. No electric lights.

History.—Built in '87 by city. Des. Engr., J. W. Nier, Kansas City, Mo. Asst. Engr., J. S. Humphrey, Garden City. Contrs., E. E. Palmer & Son, Kansas City, Mo.

Water Supply.—Surface well, pumping to stand-pipe. Well is 17½ ft. in diam., 19 ft. deep, and has 12 ft. of water.

Pumping Machinery.—Dy. cap., 1,148,000 galls.; two Buffalo comp., dup. *Boilers:* two, 55-H. P. Total pumpage for '88 was 150,000,000 galls.

Stand-Pipe.—Cap., 70,000 galls.; 10 x 130 ft.; from Contrs.

Distribution.—*Mains*, c. i., 4 miles. *Services*, not given. Pipe and specials from So. St. Louis (Mo.) Iron Foundry. *Taps*, 100. *Meters*, none. *Hydrants*, kind not given, 40.

Consumption, 411,000 galls. *Pressure:* Ordinary, 50 lbs. Fire, 80 lbs.

Financial.—Cost $55,000. Debt, $45,000. Int., 8%. Ann. op. exp., $2,500. Ann. rev.: consumers, $2,000.

Management.—Supt., I. M. Taylor.

GIRARD, *Crawford Co.* (Pop., 1,289; est., 3,000.) In coal region. Settled in '69; incorp. city in '83. No sewers. Has electric lights.

CITY WORKS.

History.—Built in '82. Des. Engr., Wm. H. Burnham.

Water Supply.—Artesian well, pumping to tank. Well is 5 ins. in diam., 890 ft. deep.

Pumping Machinery.—Dy. cap., not given; deep-well pump, driven by 25-ft. windmill made by U. S. Wind Engine & Pump Co., Batavia, Ill.; a steam engine has been provided for use in case of emergency.

Tank.—Cap., 60,000 galls.; 24 x 18 ft.; wood, on 30-ft. timber trestle.

Distribution.—(In '84,) *Mains*, c. i., 1 mile. *Services*, w. i. *Taps*, 35. *Meters*, none. *Hydrants*, 4.

Financial.—(In '84.) Cost, $10,000. Debt, $8,000. Int., 7%. Ann. op. exp., $150. Ann. rev.: consumers, $600.

Management.—(In '88.) Supt., D. B. Osborne.

PROPOSED WORKS.

General Description.—About Feb. 10, '90, Jas. S. James stated that franchise had been granted to Montauk Construction Co., 11 Wall St., N. Y. City, and that Co. had filed acceptance and bond. This is the fourth franchise granted by city. As outlined by Mr. James, July 18, '89, works will consist of 2,000,000-gall. pump, 6½ miles mains, 52 hydrants; latter at total rental of $2,800. Address Jas. S. James, or above Co.

GREAT BEND, *Barton Co.* (Pop., 1,071; est., 4,000.) On Arkansas river. Incorp. No sewers. Has electric lights.

History.—Built in '87-8 by Great Bend Water Supply Co. Engr., J. A. Jones, Oswego. Most of labor done by day.

Wat-r Supply.—Source not given, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two Buffalo. *Boiler:* from E. E. Palmer & Son, Kansas City, Mo.

Stand-Pipe.—Cap., 120,000 galls.; 12 x 150 ft.; from E. E. Palmer & Son.

Distribution.—*Mains*, 10 to 4-in. c. i., 4¼ miles. *Services*, galv. i. *Taps* (in '87), 100. *Meters*, 1. *Hydrants*, 50.

Consumption, 95,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 100 lbs.

Financial.—Cost, not given, est., $75,000. Cap. stock, $100,000. Bonded debt (in '87), $60,000. Ann. op. exp., $2,000. Ann. rev.: consumers, $2,000; city, $2,500. Hydrant rental, $50.

Management.—Prest., J. F. Thompson. El Dorado. Supts., G. N. and E. R. Moses.

GREENLEAF, *Washington Co.* (Pop., est., 1,300.)

History.—Built in '87. Ownership not given. Des. Engr., J. W. Nier, now of Nier & M tehell. Const. Engr., Kenneth Allen. Both of Kansas City, Mo. Contr., E. Sutphin, St. Louis, Mo., except for wells, National Water Supply Co., Cincinnati, O.

Water Supply.—Eight 6-in. Wagner steamed wells pumping to stand-pipe. Wells are from 56 to 60 ft. deep, and yield more than 500,000 galls. a day. Tubes are of galv. i., with screw joints.

Pumping Machinery.—Dy. cap., 500,000 galls.; Deane comp., dup.

Stand-Pipe.—Cap., 80,000 galls.; 12 x 100 ft.

Distribution.—(In '87.) *Mains*, 6 and 4-in., iron, 2 miles. *Hydrants*, 13.

Financial.—Cost, $25,000. No other data.

NOTE.—Mo. Pac. R. R. is main consumer. No reply to inquiries sent in '89.

GREENSBURGH, *Kiowa Co.* (Pop., est., 2,750.)

History.—Built in '87-8 by Greensburgh Water Supply & Hydraulic Power Co., under 30-years franchise. Des. Engr., F. W. Raeder, St. Louis, Mo. Const. Engr., D. H. Rhodes, Kingman.

Water Supply.—Well, pumping to tank and direct. Well is 30 ft. in diam., 96 ft. deep

Pumping Machinery.—Dy. cap., 150,000 galls.; two Knowles comp., dup., with 10-in. high and 16-in. low-pressure steam, and 8½-in. water cylinders of 12-in. stroke; pumps are in well, 80 ft. below surface, on rolled iron beams resting on buttresses built in sides of wall of well. *Boilers:* two Porter, 40 H. P., tubular.

Tank.—Cap., 110,000 galls.; 25 x 32 ft.; on 76-ft. oak trestle; from Jno. O'Brien Boiler Works Co., St. Louis, Mo.

Distribution.—*Mains*, c. i., 3 miles. *Services*, w. i. Pipe, specials, valves and hydrants bought of Ripley & Bronson, St. Louis, Mo.; trenching and pipe-laying done by Guido Jaeger, Rich Hill, Mo. *Taps* and *Meters*, not given. *Hydrants* (in '87), 35.

Financial.—Cost, $45,000. Cap. stock, $110,000. Bonds, authorized, $50,000. Int., 6%. Hydrant rental, $3,000 for 35, or about $85 each. Ann. op. exp. and ann. rev., not determined.

Management.—(In '88.) Prest., F. E. Gillet. V. Prest., E. W. Kinsley. Gen. Mgr. and Secy., D. H. Rhodes, Kingman, Kan.

NOTE.—No report could be obtained in '89.

HARPER, *Harper Co.* (Pop., est., 4,000.) Incorp. No sewers or electric lights.

History.—Built in '86-8 by Harper Water Co., under 21-years franchise. Engr., C. W. Hill, Wellington. Works have been in hands of receiver since Feb. 11, '89.

Water Supply.—Artesian wells, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 750,000 galls.; two Smith & Vaile comp., dup.

Stand-Pipe.—Cap., 160,000 galls.; 15 x 125 ft.; from Shickle, Harrison & Howard Iron Co., St. Louis, Mo.

Distribution.—*Mains*, c. i., 5½ miles. *Services*, iron. Pipe and specials from Shickle, Harrison & Howard Iron Co.; trenching and pipe-laying done by R. A. Wright, Harper. *Taps*, about 50. *Meters*, kind not given. 1. *Hydrants*, Chapman, 64. *Valves*, Nelson.

Consumption (in '88), 200,000 galls. *Pressure:* Ordinary, 52 lbs. Fire, 150 lbs.

Financial.—Cost (in '87), $100,000. Cap. stock, $150,000. Bonded debt, $100,000. Int., not given. Ann. op. exp., $2,000. Ann. rev.: consumers, $100; city, not given. Hydrant rental, $59.

Management.—No officers. Report from N. Norwick, Receiver.

HIAWATHA, *Brown Co.* (Pop., 1,375; est., 3,000.) Incorp. second class city. No sewers. Has electric lights.

History.—Built in '87-8 by town. Engr., J. W. Nier, now of Nier, Hartford & Mitchell, Kansas City, Mo. Contr., R. P. McCormick, Kansas City, Mo.

Water Supply.—System of small surface wells, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 500,000 galls.; two Dean, comp., cond.

Stand-Pipe. —Cap., 108,000 galls.; 12 x 130 ft.

Distribution.—*Mains,* 4 to 10-in. c. i., 5½ miles. Pipe and specials from Shickle, Harrison & Howard, Kansas City, Mo. *Taps,* 70. *Meters,* kind not given, 2. *Hydrants,* 43.

Consumption, 30,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 100 lbs.

Financial.—Cost, $58,000. Debt, $50,000. Int., 6%. Ann. op. exp., $1,400. Ann. rev., not determined.

Management.—Board of Water Comrs. City Clerk, C. H. Lawrence.

HUTCHINSON, *Reno Co.* (Pop., 1,540; est., 8,000.) On Arkansas river. Has water-power used in manufacturing. Incorp. Has sewers and electric lights.

History.—Built in '86 by Water, Light & Telephone Co. Engrs., Drake & Orton for Holly Mfg. Co., Lockport, N. Y.

Water Supply.—Driven wells in conjunction with large dug well, direct pumping. Driven wells are from 40 to 55 ft. deep.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two Gaskill, vertical, one 2,000,000 comp., cond., one 1,000,000 high-pressure. *Boilers:* 4 Otis steel, 5 x 16 ft., added in '89.

Distribution.—*Mains,* c. i., 9½ miles. *Services,* not given. *Taps,* 347. *Meters,* Worthington, Hersey, 11. *Hydrants,* Holly, 111. *Valves,* Peet.

Consumption, 425,000 galls. *Pressure:* Ordinary, 45 lbs. Fire, 200 lbs.

Financial.—Cost not separated from telephone and electric light figures; est., $75,000. Ann. op. exp., not known, est., $1,500. Ann. rev.: consumers, $5,541; city, $7,980.

Management.—Prest., M. C. Orton, Geneva, Ill. Secy., Treas. and Supt., C. A. Feebe.

INDEPENDENCE, *Montgomery Co.* (Pop., 2,945; est., 5 000.) On Verdigris river. Incorp. No sewers. Has electric lights.

History.—Built in '85 by Independence Water Co., under 20-years franchise. Contr., A. H. McCormick, Parsons, Kan.

Water Supply.—Verdigris river, pumping to tank and direct.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; Smith & Vaile. *Boilers:* steel; from Fairbanks, Morse & Co.

Tank.—Cap., 100,000 galls.; 24 x 30 ft.; steel; on tower 80 ft. high.

Distribution.—*Mains,* c. i., 6¼ miles. Trenching and pipe-laying done by C. M. Davison, Pittsburgh. *Services,* w. i. *Taps,* 245. *Meters,* 10. *Hydrants,* Nelson, 53.

Consumption, 65,000 galls. *Pressure:* Ordinary, 35 lbs. Fire, 125 lbs.

Financial.—Cost, $85,000. Capital stock, $100,000. Debt, $58,000: $3,000 at 8, $55,000 at 7%. Ann. op. exp., $1,600. Ann. rev.: consumers, $2,150; city, $3,150. Hydrant rental, $50 for 50, $50 for additional.

Management.—Prest. and Supt., L. C. Mason. Secy., J. Ferguson.

JUNCTION CITY, *Davis Co.* (Pop., 2,634; est., 4,500.) On Smoky Hill and Republican rivers. Has water-power, and is engaged in manufacturing and trade. Incorp. city of second class. No sewers. Has electric lights.

History.—Built in '87 by town. Des. Engr., J. B. Johnson, St. Louis, Mo. Contrs., Cook & Heaton.

Water Supply.—Wells, pumping to reservoir. Additional wells were sunk and pumping station moved in '89, increasing water supply to 500,000 galls. per day, at additional cost of $15,000.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two Deane.

Reservoir.—Cap., 500,000 galls.

Distribution.—*Mains,* 10 to 4-in. c. i., 6 miles. *Services,* iron. *Taps,* 140. *Meters,* none. *Hydrants,* Mathews, 52.

Consumption, 40,000 galls. *Pressure:* Ordinary, 80 lbs. Fire, 120 lbs.

Financial.—Cost, $60,000. Debt, $60,000: $10,000 at 7, $50,000 at 6%. Ann. op. exp., $1,200. Ann. rev.: consumers, $1,550.

Management.—City Council. Clerk, J. B. Callen. Supt., C. T. Wisler.

KANSAS CITY, *Wyandotte Co.* See Kansas City, Mo.

KANSAS STATE PENITENTIARY, *Lansing, Leavenworth Co.* (Pop., 500.)

History.—Built in '84 by State, for its own use, but water is supplied to few consumers in village of Lansing. Engr., Major Waron. Labor done by convicts.

Water Supply.—Missouri river, pumping to reservoir.

Pumping Machinery.—Dy. cap., not given; 340,000 Hooker-Colville. and new pump added in '89.

Reservoir.—Cap., 2,000,000 galls ; 100 x 200 ft., x 15 ft. 10 ins. deep; masonry walls backed with earth. Walls 4 ft. thick at top, 9 at bottom; on cem. foundation, 11½ ft. wide; rubble masonry, with 26-in. perpendicular wall of cut stone masonry in cem on water side. Earth embankment 12 ft. wide on top, with outer slope of 6 to 1. Built in '84 by convict labor. Engr., —— Mason. Cost, $12,000.

Distribution.—*Mains*, 8-in. c. i., 2 miles. *Services*, kind not given. *Taps*, 36. *Meters*, none. *Hydrants*, 8, one of which is for the town.

Consumption, 80,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—Cost, $60,000. No debt. Ann. op. exp., est., $1,000. Ann. rev.: from consumers, in village, $40.

Management.—Engr., Dan. Storrs.

KINGMAN, *Kingman Co.* (Pop., 970; est., 6,000.) On Ninnescah river. Incorp. No sewers. Has electric lights.

History.—Built in '86-7 by Kingman Water & Power Co., under 30-years franchise. Name changed in Mar. '89, to Kingman Water & Light Co. Des. Engr., F. Wm. Raeder, St. Louis, Mo. Const. Engr., N. W. Perkins. Contrs., Water & Light Co., St. Louis, Mo.

Water Supply.—Source not given, pumping to tank.

Pumping Machinery.—Dy. cap., 500,000 galls.; Gordon & Maxwell. *Boilers:* two 60-H. P.; from Jno. O'Brien Boiler Works, St. Louis, Mo.

Tank.—Cap., 70,000 galls.; at elevation of 113 ft.

Distribution.—*Mains*, 10 to 4-in. c. i., 5 miles. Pipe and specials from Shickle, Harrison & Howard Iron Co., St. Louis, Mo. *Taps*, 125. *Meters*, none. *Hydrants*, White, Ludlow, 48. *Valves*, White, Ludlow.

Consumption, 58,087 galls. *Pressure*, not given.

Financial.—Cost, $55,000. Debt, $60,000. Int., 6%. Ann. op. exp., $2,500. Ann. rev.: consumers, $1,250; city, $3,300. Hydrant rental, $70 for original number, $40 on extensions.

Management.—Prest., T. S. Kruts. Secy., E. Fowler. Supt., Chas. Tuttle.

KINSLEY, *Edwards Co.* (Pop., 457; est., 3,200.) Incorp. No sewers. Has electric lights.

History.—Built in '87-8 by town. Des. Engr., J. W. Nier, now of Nier, Hartford & Mitchell, Kansas City, Mo. Const. Engr., S. Jobe, Carthage, Mo. Contrs., D. Mitchell & Co., Dodge City.

Water Supply.—Well, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Deane, dup.

Stand-Pipe.—Cap., 180,000 galls.; 16 x 120 ft.

Distribution.—*Mains*, c. i., 5 miles. *Services*, w. i. *Taps*, 75. *Meters*, none. *Hydrants*, kind not given, 25.

Consumption, not given. *Pressure*, 65 lbs.

Financial.—Cost, $40,000. Bonded debt, $40,000. Int., 6%. Ann. op. exp., est., $1,000. Ann. rev.: consumers, $700.

Management.—Supt., R. G. Stearns.

LARNED, *Pawnee Co.* (Pop., 1,066; est., 5,000.) Has electric lights.

History.—Built in '87 by R. L. Walker & Co., Topeka, Kan., under 21-years franchise. Des. Engr., J. S. Simmons. Const. Engr., J. J. Nesbit, Larned. Labor done by Co. Extensive improvements made in '89.

Water Supply.—Well, pumping to stand-pipe. Well is 30 ft. in diam., 25 ft. deep.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Deane.

Stand-Pipe.—Cap., 80,000 galls.; 12 x 100 ft.; from E. E. Palmer & Sons, Kansas City, Mo.

Distribution.—(In '88.) *Mains*, c. i., 4 miles. *Services*, w. i. *Taps*, 125. *Meters*, not given. *Hydrants*, Nelson, 50. *Valves*, Nelson.

Consumption, 150,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 125 lbs.

Financial.—(In '88.) Hydrant rental, $60 each. No other data.

Management.—(In '88.) Prest., N. A. English. Secy., A. N. Jones. Supt., J. J. Nesbit.

LAWRENCE, *Douglass Co.* (Pop., 8,510; est., 13,000.) On Kansas river. Has water-power and manufactories. Incorp. Has sewers and electric lights.

KANSAS WATER & LIGHT CO.

General Description.—Organized in '89 to operate works at Lawrence and Paola. Debt, $250,000. Int., 6%. Sinking fund, 2% annually, after 10 years. Prest., Chas. Whann. Secy., Chas. B. Ludwig, 72 Broadway, N. Y. City.

LOCAL PLANT.

History.—Built in '86-7 by City Water Co., under 20-years franchise. Operated since '89 by Kansas Water & Light Co., described above. Des. Engr., S. H. Lockett, N. Y. City. Const. Engr., Jno. M. Walker, present Supt. Contrs., Comegys & Lewis, N. Y. City.

Water Supply.—Kansas river, filtered, pumping to stand-pipe. Settling basins built in '89 or '90.

Settling Basins.—No data.

Pumping Machinery.—Dy. cap., 2,500,000 galls.; Worthington. *Boiler:* Heine, safety.

Filters.—Dy. cap. (rated), 1,000,000; two National. "At times can't get enough to wash."

Stand-Pipe.—Cap., 240,000 galls.; 20 x 105 ft.; from Shickle, Harrison & Howard Iron Co., St. Louis, Mo.

Distribution.—(Jan. 1, '90.) *Mains*, c. i., 18 miles. *Services*, lead. Pipe and specials from Shickle, Harrison & Howard Iron Co.; trenching and pipe-laying done by Jno. Maxwell, Leavenworth, Kan. *Taps*, 650. *Meters*, kind not given, 8. *Hydrants*, White, 144. *Valves*, Peet.

Consumption, 200,000 galls. *Pressure*, 100 lbs.

Financial.—(Jan. 1, '90.) Cost, $210,000. Ann. op. exp., $3,500. Ann. rev.: consumers, $13,000; city, $4,600. Hydrant rental, $30.

Management.—Supt. (May 15, '89), Jno. M. Walker.

NOTE.—See Kansas Water & Light Co., above.

LEAVENWORTH, *Leavenworth Co.* (Pop., 16,546; est., 31,000.) On Missouri river, 30 to 130 ft. above it, and surrounded by semicircular range of hills 350 ft. high. Has various manufactories. Settled and incorp. city in '54. Has sewers and electric lights.

History.—Built in '82 by Leavenworth City and Fort Leavenworth Water Co., under 20-years franchise. Des. Engr., Galen W. Pearsons, Kansas City, Mo. Const. Engr., T. J. Whitman, St. Louis, Mo.

Water Supply.—Missouri river, pumping to settling basins, and repumping to reservoir.

Pumping Machinery.—Dy. cap., 15,000,000 galls., including pumps used for repumping; 4,000,000 Gaskill horizontal; 3,000,000 and 2,000,000 Pearson, and 6,000,000 Worthington. *Boilers:* six tubular, from J. Newsome & Sons and Holly Mfg. Co.

Settling Basins.—Cap., 6,000,000 galls. Are 100 ft. below river.

Reservoirs.—Cap., 6,000,000 galls.; 216 ft. in diam., 16 ft. deep, and 350 ft. above river.

Distribution.—*Mains*, c. i., 25 miles. Pipe and specials from D. Long & Co., Louisville, Ky., and Shickle, Harrison & Howard, St. Louis, Mo.; trenching and pipe-laying done by Fenn & Yoakum. *Services*, galv. i., lead. *Taps*, 1,210. *Meters*, 337. *Hydrants*, Ludlow, 122. *Valves*, Ludlow, Chapman. *Pressure-recording gauge*, Edson.

Consumption, 250,000 galls. *Pressure*, 125 lbs.

Financial.—Cost (in '87), $375,000. Bonds, $600,900. Int., 6%. Ann. op. exp., $16,000 Ann rev.: consumers, $41,675; city, $9,150. Hydrant rental, av., about $80.

Management.—Prest., L. T. Smith. Secy. and Treas., Wm. I. Hewitt. Supt., S. Hastings.

McPHERSON, *McPherson Co.* (Pop., 1,990; est., 6,000.) On prairie. Incorp. city. No sewers. Has electric lights.

History.—Built in '83 by city and extended in '88. Des. Engr., A. A. Richardson, Lincoln, Neb. Const. Engr., W. H. Nelson, McPherson. Labor done by city. Unofficially reported that city has sold works to Union Water Supply Co.

Water Supply.—Two wells, 145 ft. deep, pumping to tank.

Pumping Machinery.—Dy. cap., 275,000 galls.; Cook.

Tank.—Cap., 65,000 galls.; of wood, on 41-ft timber trestle in center of city.

Distribution.—*Mains*, 10 to 4-in. w. i., 2 miles. *Services*, w. i. *Taps*, 200. *Meters*, none. *Hydrants*, Fairbanks, 20.

Consumption (in '87), 200,000 galls. *Pressure:* Ordinary, 20 lbs. Fire, 80 lbs.

Financial.—(In '87.) Cost, $25,000. Debt, $200,000. Int., 6%. Ann. op. exp., not given, est., $1,750. Ann. rev.: consumers, $4,000.

Management.—City Clerk, D. C. Welch. Supt., A. Gross.

MANHATTAN, *Riley Co.* (Pop., 2,105; est., 5,000.) At Junction of Big Blue and Kansas rivers. Has water-power. Incorp. No sewers. Has electric lights.

History.—Built by city. Engr., J. W. Nier, now of Kansas City, Mo.

Water Supply.—Filter gallery, pumping to reservoir.

Pumping Machinery.—Dy. cap., 750,000 galls.; two Deane comp., cond., dup. *Boilers.* two, 4½ x 14 ft.

Distributing Reservoir.—Cap., 1,200,000 galls.

Distribution.—*Mains,* 8 miles. *Taps,* 142. *Meters,* none. *Hydrants,* 48.

Consumption, 50,000 galls. *Pressure,* 85 lbs.

Financial.—Cost, $72,000. Debt, $70.000. Int., 6%. Ann. op. exp., about $1,650. Ann. rev.: consumers, $1,800.

Management.—Water Com. Chn., L. McCollough. Supt., Geo. E. Hopper.

MARION, *Marion Co.* (Pop., 857; est., 3,500.) On Cottonwood river. Incorp. No sewers. Has electric lights.

History.—Built in '87 by Marion Water Supply, Electric Light & Power Co., under 21-years franchise. Contrs., E. E. Palmer & Son, Kansas City, Mo.

Water Supply.—Well, pumping to stand-pipe and direct.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two Volker & Felthousen, one comp., dup., and one single high-pressure; from Pond Engineering Co., St. Louis, Mo.

Stand-Pipe.—Cap., 85,000 galls.; 10 x 150 ft.; from Contrs.

Distribution.—*Mains,* kal i., 6 miles. *Services,* galv. i. Pipe and specials from National Tube Works Co., McKeesport, Pa. *Taps,* 35. *Meters,* kind not given, 7. *Hydrants,* kind not given, 50.

Consumption, 30,000 galls. *Pressure,* 70 lbs.

Financial.—Cost, $80,000. Cap. stock. $100,000. Bonded debt, $70,000. Ann. op. exp., $5,000 (including electric lights). Ann. rev.: consumers, $1,000; city, $2,500. Hydrant rental, $50.

Management.—Prest., E. L. Thompson, El Dorado. Secy., J. A. Jones, Oswego. Treas., E. E. Palmer, Kansas City, Mo. Supt., Taylor Riddle.

MARYSVILLE, *Marshall Co.* (Pop., 1,249; est., 3,100.) Has flour mill and cigar manufactory. Incorp. city. No sewers. Has electric lights.

History.—Built in '89 by Marysville Water Co., under 20-years franchise; put in operation Feb. 4, '90. Engr., J. S. Simmons.

Water Supply.—Twenty driven wells near Blue river, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 1,750,000 galls.; Worthington, 1,000,000 comp., dup., 750,000 high-pressure, dup. *Boilers:* from W. M. Leckie, Joplin, Mo.

Stand-Pipe.—Cap., 50,000 galls.; 10x100 ft., from Thos. F. Peckham, Hutchinson.

Distribution.—*Mains,* 10 to 4-in. c. i., 4½ miles; from So. St. Louis (Mo.) Foundry; laid by Co. *Services,* lead, w. i. *Meters,* Hersey, number not given. *Hydrants,* Nelson, 50. *Valves,* Pect.

Pressure, 87 lbs.

Financial.—Cost, 50,000. Cap. stock, authorized $40,000. Bonded debt, $12,000. Bonds authorized. $75 000. Int., 6%. Ann. op. exp., est., $1,200. Ann. rev.: consumers, est., $3,500; city, $2,500. Hydrant rental, $50.

Management.—Prest., E. E. Stevens, Beloit. Secy., J. S. Simmons. Report, Apr. 1, '90.

MEDICINE LODGE, *Barbour Co.* (Pop., 373; est., 1,600.)

History.—(See Note below.) Built in '89-90 by Co., under franchise granted to Chas. H. Eldred; completed and tested Feb. 8, '90. City furnished supply. Des. Engr., Kenneth Allen. Const. Engr., D. J. Aber.

Water Supply.—Elm creek, by gravity to pump, thence by direct pumping; filtered.

Ditch.—From creek to or near city, about 4 miles long; dy. cap., about 8,000,000 galls.; has fall of 60 or 70 ft. Built in '88 by city; cost, $13,000.

Pumping Machinery.—No data, but probably water-power.

Distribution.—*Mains,* 10 to 4-in., about 2½ miles. *Hydrants,* 20.

NOTE.—No further data. Subject to correction, as above was given before beginning of construction, excepting date of completion.

MINNEAPOLIS, *Ottawa Co.* (Pop., 1,084; est., 3,000.) On Solomon river. Has water-power used in manufacturing. No sewers. Has electric lights.

History.—Built in '87 by Minneapolis Water Co., under 20-years franchise. Des. Engr., B. R. Clarke, Boston, Mass. Const. Engr., T. J. Talbot. Contrs., Turner, Clarke & Rawson, Boston, Mass.

Water Supply.—Wells, connected by tunnel, by direct pumping. There are two wells, each 6 x 12 ft., one 40 and other 44 ft. deep, sunk 70 ft. apart, near Solomon river, through brown sandstone. Tunnel 6 ft. sq. connects two, and extends beyond first, making total length of 94 ft. In bottom of first well are four 6-in. and of second four 5-in. drilled wells, deepest extending 73 ft. Only one well was sunk at first, but this not meeting demand, source of supply was extended. Water stands 13 ft. deep in wells. Daily yield is about 1,000,000 galls., and temperature of water is 60 degrees F.

Pump-Well.—First well serves this purpose, being enlarged to depth of 16 ft. from top to receive pumps.

Pumping Machinery.—Dy. cap., 1,750,000 galls.; two Blake, one comp. and one single, dup. *Boilers:* two, 60-H. P., return, tubular; from Pond Engineering Co., St. Louis, Mo.

Distribution.—*Mains*, c. i., 4¼ miles. *Services*, galv. i. Pipe and specials from Gloucester Iron Works, Philadelphia, Pa., and Cincinnati & Newport Iron & Pipe Co., Newport, Ky. *Taps*, 275. *Meters*, 10 *Hydrants*, Ludlow, 51. *Valves*, Chapman.

Consumption and *Pressure*, not given.

Financial.—Cost, withheld, est., $75,000. Cap. stock, $100,000. Debt, withheld. Ann. op. exp., withheld, est., $2,500. Ann. rev.: consumers, withheld, est., $5,000. Hydrant rental, $2,745 for 51, or $53.82 each; $45 for additional.

Management.—Prest., A. B. Turner, Boston, Mass. Secy., A. Gilbert. Treas., J. Wentworth Brown. Supt., W. F. Brown.

NEWTON, *Harvey Co.* (Pop., 2,601; est., 12,000.) On Sand creek on level land. Incorp. Has sewers and electric lights.

History.—Built in '84 by Newton Water Co., under perpetual franchise, unless city buys works. Engr., T. S. Moorhead, Milton, Pa.

Water Supply.—Two batteries Wagner, pumping to stand-pipe.

Dam and Impounding Reservoir.—Cap., 10,000,000 galls. Dam is 210 ft. long, 8 ft. wide on top and 16 ft. high. Two rows of sheet-piles were first driven and [probably] filled between with earth.

Filter and Tunnel.—Filter consists of stone culvert under bed of creek, 67 x 10 ft., x 4 ft. high. Upon top of this are brick, and above them 3 ft. of sand. At end of filter is masonry pier enclosing gate leading to tunnel. Latter is 12 ft. wide, 65 ft. long and ends in pump-well, at point 8 ft. above its bottom.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two Worthington, one of 12 and 18-in. steam and 14-in. water cylinders, and other of 18½-in. steam and 14-in. water cylinders, all of 10 in. stroke.

Stand-Pipe.—Cap., 400,000 galls.; 30 x 76 ft.; iron; 45 ft. masonry tower; ground is 20 to 25 ft. above city.

Distribution.—*Mains*, c. i., 15 miles. *Services*, galv. i. *Taps*, 400. *Meters*, kind not given, 50. *Hydrants*, Nelson, 112.

Consumption, 500,000 galls. *Pressure:* Ordinary, 40 to 60 lbs. Fire, 150 lbs.

Financial.—Cost, $210,000. Cap. stock, $200,000. Bonded debt, $158,000. Int., 6%. Ann. op. exp., $4,000. Ann. rev.: consumers, $11,800; city, $6,720. Hydrant rental, $60.

Management.—Secy. and Treas., W. I Graham. Supt., Jno. E. Ford.

NORTON, *Norton Co.* (Pop., est., 2,200.) No sewers. Has electric lights.

History.—Built in '88 by town. Des. Engr., Jno. W. Nier, Kansas City, Mo. Const. Engrs., Davis & Worthington, Norton. Contr., E. Sutphin, St. Louis, Mo.

Water Supply.—Eight Wagner wells, 23 ft. deep, pumping to stand-pipe and direct.

Pumping Machinery.—Dy. cap., 500,000 galls.; Deane.

Stand-Pipe.—Cap., 80,000 galls.; 12 x 100 ft.

Distribution.—*Mains*, 6 and 4-in. c. i., 5 miles. *Services*, w. i. *Taps*, 200. *Meters*, none. *Hydrants*, Ludlow, 21. *Valves*, Arthurs.

Consumption, 300,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 200 lbs.

Financial.—Cost, $37,000. Bonded debt, $37,000. Int., 6%. Ann. op. exp., $1,200. Ann. rev.: consumers, $1,400.

Management.—Treas., M. Heaton. Supt., C. E. Worthington.

OBERLIN, *Decatur Co.* (Pop., 1,196; est., 2,000.) Incorp. No sewers or electric lights.

History.—Built in '88 by town; put in operation Jan. 1, '89. Des. Engr., A. A. Richardson, Lincoln, Neb. Contr., Ben. S. Clarke, Holdredge, Neb.

Water Supply.—Tube wells, pumping to stand-pipe and direct. There are 32 3-in. wells, 35 ft. deep.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Gordon & Maxwell, dup.

Stand-Pipe.—Cap., 80,000 galls.; 12 x 100 ft.

Distribution.—*Mains*, c. i., 3¾ miles. *Services*, not given. *Taps*, 40. *Meters*, none. *Hydrants*, Adams, 23.

Consumption, 45,000 galls. *Pressure:* Ordinary, 72 lbs. Fire, 120 lbs.

Financial.—Cost, $30,000. Bonded debt, $30,000. Int., 6%. Ann. op. exp., $2,000. Ann. rev.: consumers, est., $1,500.

Manag ment.—City Council. Mayor, W. T. S. May. City Clerk, Geo. W. Keys.

OLATHE, *Johnson Co.* (Pop., 2,285; est., 5,000.) On Missouri river. No sewers. Has electric lights.

History.—Built in '84 by town. Consult. Engr., Galen W. Pearsons, Kansas City, Mo. Const. Engr., D. W. Pike. Labor by local Contrs.

Water Supply.—Surface water gathered in impounding reservoir and filtered, pumping direct.

Filter.—Cap., 150,000 galls.: Hyatt, erected in Oct., '87.

Pumping Machinery.—Dy. cap., 750,000 galls.; Gaskill dup.

Reservoir.—Cap., 20,000,000 galls.

Distribution.—*Mains*, c. i., 5 miles. *Services*, galv. i. *Taps*, 120. *Meters*, 1. *Hydrants*, kind not given, 47.

Consumption, 65,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—Cost, $40,000. Debt, $37,000. Int., 7%. Ann. op. exp., $1,500. Ann rev.: consumers, $5,000.

Management.—Supt., Geo. H. Beach.

OSWEGO, *Labette Co.* (Pop., 943; est., 4,000.) On Neosho river, which furnishes water-power used in milling. Incorp. city of second class. No sewers. Has electric lights.

History.—Built in '87 by Oswego Water Supply Co., under 21-years franchise. Engr. and Contr., J. Jones, Wichita. Works are now in hands of Receiver.

Water Supply.—Neosho river, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 1,700,000 galls.; two 850,000 Buffalo, dup., from N. O. Nelson Mfg. Co., St. Louis, Mo.

Stand-Pipe.—Cap., 65,000 galls.; 10 x 140 ft.; from E. E. Palmer & Son, Kansas City, Mo.

Distribution.—(In '87.) *Mains*, c. i., 6 miles. Pipe and specials from So. St. Louis (Mo.) Foundry. *Taps*, 100. *Meters*, 60. *Hydrants*, Nelson, 50.

Consumption, not given. *Pressure:* Ordinary, 65 lbs. Fire, 125 lbs.

Financial.—(In '87.) Cost, $60,000. Cap. stock, $100,000. Bonded debt, $40,000. Int., 6%. Ann. op. exp., $4,000. Ann. rev.: consumers, withheld, est., $3,000; city, $2,500. Hydrant rental, $50.

Management.—Receiver, M. S. Douglass. Report from Thos. Bulwer, City Clerk.

OTTAWA, *Franklin Co.* (Pop., 4,032; est., 8,000.) On Marais des Cygnes river. Has foundries and railway machine shops, and manufactures flour, furniture, sugar and castor oil. Incorp. Has sewers and electric lights.

History.—Built in '86 by C. T. Ewing, Thayer. Const Engr., J. H. Hess, Ottawa.

Water Supply.—Marais des Cygnes river, and well, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two Deane, one comp. and one high-pressure. *Boilers:* two, steel, tubular.

Stand-Pipe.—Cap., 70,000 galls.; 10 x 125 ft.; from Mid-Continental Boiler Works, Kansas City, Mo.

Distribution.—*Mains*, c. i., 10 miles. *Services*, galv. i. Pipe from Chattanooga (Tenn.) Foundry & Pipe Works. *Taps*, 300. *Consumers*, 340. *Meters*, 4. *Hydrants*, Chapman, 77. *Valves*, Chapman.

Consumption, 300,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 110 lbs.

Financial.—Cost, $110,000. Bonded debt, $80,000. Int., 6%. Ann. op. exp., $2,640. Ann. rev.: consumers, $6,765; city, $3,200. Hydrant rental, $42.50.

Management.—Owner, C. T. Ewing, Thayer. Secy. and Treas., Wm. Mitchell.

PAOLA, *Miami Co.* (Pop., 2,312; est., 4,000.) Incorp. No sewers. Electric lights projected in '89.

History.—Built in '85-6 by Paola Water Co., under 20-years franchise. Operated since '89 by Kansas Water and Light Co., which see under Lawrence. Des. Engr., G. W. Pearsons, Kansas City, Mo. Const. Engr., S. H. Lockett. Contrs., Comegys & Lewis. Both of N. Y. city.

Water Supply.—Bull creek, filtered, pumping to stand-pipe and direct.

Old Filter Crib.—Made of 10-in. timbers, and filled with sand and gravel. Is 24 x 40 ft., with 4-ft. filter spaces on sides and top. Sunk in winter through ice.

New Filter.—Dy. cap., 300,000 galls.; Hyatt; built in June, '87.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two Worthington comp., dup. *Boilers:* steel, tubular.

Stand-Pipe.—Cap. 80,000 galls.; 12½ x 100 ft.; from Shickle, Harrison & Howard Iron Co., St. Louis, Mo.

Distribution.—(Jan. 1, '90.) *Mains*, c. i., 5¾ miles. *Services*, galv. i. Pipe and specials from Shickle, Harrison & Howard Iron Co. *Taps*, 381. *Meters*, none. *Hydrants*, Ludlow, 57. *Valves*, Ludlow.

Consumption, 160,000 galls. *Pressure:* Ordinary, 65 lbs. Fire, 100 lbs.

Financial.—(Jan. 1, '90.) Cost, $90,000. Ann. op. exp., $1,500. Ann. rev.: consumers, $4,000; city, $3,900. Hydrant rental, $60.

Management.—Supt., E. W. Robinson.

NOTE.—See Kansas Water & Light Co., under Lawrence.

PARSONS, *Labette Co.* (Pop., 4,199; est., 10,000.) On Big Labette creek on rolling prairie land. Settled and incorp. city in '71. Has sewers and electric lights.

History.—Built in '83 by Parsons Water Co. Des. Engr., P. B. Perkins. Const. Engrs., Chas. W. Hill and A. H. McCormick.

Water Supply.—Big Labette creek, filtered and settled, pumping to tank and direct. Creek rises about 20 miles north of city.

Dam.—Across creek; on bed rock, being 12 ft. wide at base, 7 at top and 12 ft. high. Length not given. Of stone in Fort Scott hydraulic cem.

Filter Gallery.—Built above dam in bed of stream, and consists of excavation 10 x 50 ft., x 7 ft. deep, covered with timbers ⅝ in. apart, on which is 4-ft. bed of tone and gravel.

Settling Reservoir.—Water passes from filter to two settling reservoirs, each having cap. of 2,500,000 galls. They are in excavation, with inner slopes paved with 10 ins. of stone, grouted and plastered with cem.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Smith & Vaile. *Boilers:* upright.

Tank.—Cap., 52,670 galls.; 18 x 24 ft.; on 80-ft. masonry tower, 147 ft. above pumps.

Distribution.—*Mains*, c. i., 9½ miles. *Services*, w. i., lead. *Taps*, 300. *Meters*, 10. *Hydrants*, White, Chapman, 54. *Valves*, Chapman.

Consumption, 300,000 galls. *Pressure:* Ordinary, 50 lbs. Fire, 120 lbs.

Financial.—Cost, $95,000. Debt, $65,000: $15,000 at 8, $50,000 at 6%. Ann. op. exp., $2,200. Ann. rev.: consumers, $4,700; city, $3,200. Hydrant rental, $100 for 30, $50 for additional.

Management.—Prest., C. H. Kimball. Supt. and Secy., W. K. Hayes.

PEABODY, *Marion Co.* (Pop., 1,087; est., 2,500.) Manufactures carriages and windmills. Incorp. No sewers or electric lights.

History.—Built in '86 by town. Contrs., U. S. Steam & Wind Pump Co.

Water Supply.—Wells, pumping to tank and direct. There are five wells, one furnishing water raised by windmill pump, and others by steam pump.

Pumping Machinery.—Dy. cap., 500,000 galls., Knowles steam, and pump driven by 22-ft. windmill.

Tank.—Cap., 60,000 galls.

Distribution.—*Mains*, w. i., 3 miles. *Services*, galv. i. *Taps*, 42. *Meters*, none. *Hydrants*, Eclipse, 25. *Valves*, Ludlow.

Consumption, 18,000 galls. *Pressure:* Ordinary, 55 lbs. Fire, 70 lbs.

Financial.—Cost, $19,000. Debt, $15,000. Int., 7%. Ann. op. exp., $200. Ann. rev.: consumers, $300.

Management.—Supt., E. F. Davidson. Chf. Fire Dept., L. L. Morrill.

PITTSBURGH, *Crawford Co.* (Pop., est., 5,000.) Incorp. Has sewers Has electric lights.

History.—Built in '85 by Pittsburgh Water & Irrigating Co., under 21-years franchise; put in operation Jan. 1, '86. Const. Engr., A. H. McCormick, Parsons, Kan.

Water Supply.—Artesian well, pumping to tank and direct.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Worthington.

Tank.—Cap., 67,000 galls.; 24 x 20 ft.

Distribution.—*Mains*, c. i., 5 miles. *Services*, w. i. Pipe and specials from Shickle, Harrison & Howard Iron Co., St. Louis, Mo.; trenching and pipe-laying done by Chas. Davidson, Pittsburgh. *Taps*, 180. *Meters*, 21. *Hydrants*, Nelson, 30.

Consumption, 200,000 galls. *Pressure:* Ordinary, 45 lbs. Fire, 90 lbs.

Financial.—Cost, $55,000. Cap. stock, $100,000. Bonded debt, $30,000. Int., 7%. Ann. op. exp., $1,200. Ann. rev.: consumers, $1,000; city, $1,600. Hydrant rental, $60 and $50.

Management.—Prest., Frank Playtes. Secy., J. M. Goff. Supt., C. M. Davison.

PLEASANTON, *Linn Co.* (Pop., 709; est., 1,320.) In Potosi township in coal region.

History.—Built by town, date not given. No Engr. employed.

Water Supply.—Artificial lake, pumping to reservoir.

Dam and Reservoir.—Cap., 160,000 galls.; stone, on natural mound in center of town. Dam, not described.

Pumping Machinery.—Dy. cap., not given; driven by windmill; steam pump in reserve for calms and accidents.

Distribution.—*Mains*, 8, 6, and 4-in. w. i., c. i., 4,900 ft. *Taps*, *Meters*, and *Hydrants*, not given. In '89, 8,000 ft. of mains and 20 hydrants were added.

Consumption, not given. *Pressure*, 40 lbs.

Financial.—Cost, $13,000. Debt, $10,000. Int., 7%. No op. exp. Ann. rev.: consumers, $700.

Management.—Supt., L. C. Crop. Report by S. H. Allen.

PRATT, *Pratt Co.* (Pop., est., 600.) Has electric lights.

General Description.—Built by city prior to '89. Address W. E. McCampbell, Engr., or Marion Coats.

SALINA, *Salina Co.* (Pop., 3,111; est., 10,000.) On Smoky Hill river, on level ground. Incorp. Partially sewered. Has electric lights.

History.—Built in 83 by Salina Water-Works Co., under 20-years franchise. No Engr. employed by Co. Contrs., Orton, Drake & Bonebrake.

Water Supply.—Well, 38 ft. deep, direct pumping. In bottom of well are 50 tubes driven 75 ft. to second strata of gravel, from which all water comes. Connection has been made with the Smoky Hill river for use in emergency.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Gaskill horizontal, comp., cond.

Distribution.—*Mains*, c. i., 8½ miles. *Services*, galv. i. *Taps*, 357. *Meters*, kind not given, 17. *Hydrants*, Holly, 61. *Valves*, Peet. *Pressure-recording gauge*, Edson.

Consumption, 150,000 galls. *Pressure*: Ordinary, 20 lbs. Fire, 80 lbs.

Financial.—Cost (in '87), $102,000. Cap. stock, $100,000. Bonded debt, $92,000. Int., 6%. Ann. op. exp. (in '87), $5,000. Ann. rev.: consumers (in '87), $7,500; city, $6,050. Hydrant rental, $100 for first 50, $75 for next 25, and $50 for additional.

Management.—Prest., C. H. Payson, Portland, Me. Secy., Treas. and Supt., J. H. Decker.

SMITH CENTRE, *Smith Co.* (Pop., est., 1,290.) Trade center. No sewers or electric lights.

History.—Built in '89-90 by city; put in operation Jan. 15. Des. Engr., A. A. Richardson, Lincoln, Neb. Labor done by city.

Water Supply.—Beaver creek, pumping direct and to stand-pipe; filtered.

Filter.—Broken stone and charcoal.

Pumping Machinery.—Dy. cap., not given; Buffalo. *Boiler:* from Brownell & Co., Omaha, Neb.

Stand-Pipe.—Cap., 64,000 galls.; 10 x 110 ft.; from Porter, Jackson & Co., Chicago, Ill.

Distribution.—*Mains*, 6 and 4-in. kal. i., 4 miles. *Services*, ¾-in. Pipe and specials from National Tube Works Co., McKeesport, Pa. *Taps*, 125. *Hydrants*, Tamaqua, 20. *Valves*, U. S. Wind Engine & Pump Co.'s.

Pressure: Ordinary, 60 lbs. Fire, 120 lbs.

Financial.—Cost, $23,000. Debt, $25,000. Int., 6%.

Management.—Mayor, E. Slocum. Report, Feb. 10, '90.

SPRINGFIELD, *Seward Co.* (Pop., est., 1,000.)

General Description.—Springfield Light, Heat & Water-Works Co. was incorp. in '88, with cap. stock of $30,000, and began construction of works. May, '89, city purchased works and made arrangements for their completion. As originally designed by J. S. Humphrey, Garden City, 750,000-gall. Deane pump was to lift water to 68,000-gall. stand-pipe, 12 x 80 ft., from E. E. Palmer & Son, Kansas City, Mo.; there were to be 1¾ miles of 10 to 6-in. c. i. mains, from So. Pittsburgh (Tenn). Foundry, 20 Chapman hydrants, and Chapman valves; est. cost, $26,000. Const. Engr., Ed. A. Watson, Springfield.

STERLING, *Rice Co.* (Pop., 1,014; est., 2,800.) Incorp. city of third class. No sewers. Has electric lights.

History.—Built in '87 by city. Engr., Jno. W. Nier, Kansas City, Mo. Labor by local Contrs. Water used chiefly for lawns.

Water Supply.—Thirty-eight 2-in. driven wells, direct pumping.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; two Deane. *Boilers:* from Diamond Boiler Works, Kansas City, Mo.

Distribution.—*Mains*, 10 to 4-in., c. i., 4¾ miles. *Services*, not given. Pipe and specials from Chattanooga (Tenn.) Foundry & Pipe Works. *Taps*, 122. *Meters*, none. *Hydrants*, Galvin, 40. *Valves*, Galvin.

Consumption, about 10,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—Cost, $50,000. Debt, $42,000. Int., 6%. Sinking fund, $7,000. Ann. op. exp., $1,900. Ann. rev.: consumers, $700.

Management.—City Treas., H. Irish. Report by J. T. Gaskell.

STOCKTON, *Rooks Co.* (Pop., 411; est., 2,000.) On south fork of Solomon river. No sewers. Has electric lights.

History.—Built in '87 by town. Des. Engr., Jno. W. Nier, Kansas City, Mo. Asst. Engr., W. C. Sanford, Stockton. Contr., E. Sutphin, St. Louis, Mo.

Water Supply.—Well, pumping to stand-pipe and direct. Well is 18 x 34 ft. Additional well, 12 ft. in diam., 9 ft. deep, was dug in '88. Pump draws from both wells till old well is exhausted, after which new well is used as feeder, by gravity, for old well. New well, 1,420 ft. from pumps.

Pumping Machinery.—Dy. cap., 500,000 galls.; Deane comp., dup.

Stand-Pipe.—Cap., 80,000 galls.; 12 x 100 ft.; on elevation of 86 ft.: from Diamond Boiler Works, Kansas City, Mo.

Distribution.—*Mains*, c. i., 4.7 miles. *Services*, w. i. Trenching and pipe-laying done by Parker & Lake, Clyde, Kan. *Taps*, 120. *Meters*, none. *Hydrants*, kind not given, 24.

Consumption, 25,000 galls. *Pressure:* Ordinary, 80 lbs. Fire, 145 lbs.

Financial.—Cost, $34,300. Debt, $34,300. Int., 6%. Ann. op. exp. $1,000., Ann. rev.: consumers, $1,100.

Management.—Secy., H. H. Olney. Supt., Wm. C. Sanford.

TOPEKA, *Shawnee Co.* (Pop., 15,452; est., 40,000.) On Kansas river on undulating prairie. Engaged in manufacturing and trade. Settled in '56; incorp. city in '57. Has sewers and electric lights.

History.—Built in '81-2 by private Co., name not given. Franchise runs for 99 years, but city has privilege of buying works at end of any 20 years. Contrs., Russell & Alexander.

Water Supply.—Kansas river, through two wells, by direct pumping. First well is 75 ft. in diam., on island in river, 80 ft. from its shore, and is sunk 7 ft. below river bottom. Sides are cemented. Second well is 60 ft. in diam. Suction pipe leads from first well to pump-house near river bank.

Pumping Machinery.—Dy. cap., 7,000,000 galls.; two 1,500,000 Holly quadruplex, and 4,000,000 Gaskill horizontal.

Distribution.—(Jan. 1, '90.) *Mains*, c. i., 36½ miles. *Services*, w. i. Pipe and specials on first contract from Dennis Long & Co., Louisville, Ky. *Taps*, about 1,500. *Meters*, 85. *Hydrants*, Holly, 290. *Valves*, Ludlow.

Consumption, about 1,600,000 galls. *Pressure:* Fire, 110 lbs.

Financial.—(Jan. 1, '90.) Cost, $1,000.000. Debt, $750,000. Int., 6%. Sinking fund, 10% of earnings after 5 years. Ann. op. exp., $11,110. Ann. rev.: consumers, $56,849; city, $14,110. Hydrant rental, $44.66 for 150, $50 for additional.

Management.—Prest. and Treas., J. Mulvane. Secy., A. Bass.

NOTE.—In '89 negotiations were begun looking to sale of works to Geo. P. Westcott, Portland, Me., and Saml. Hanson, Boston, Mass., for $500,000. Later, steps were taken to transfer works to Coffin & Stanton, N. Y. City, and Woodbury & Moulton, Portland, Me., for $550,000. First parties brought injunction to stop transfer, claiming that contract for sale of works had been made to them. Injunction was granted, but results of trial were not known time of report.

UDALL, *Cawley Co.* (Pop., est., 700.)

History.—Built in '88 by village. Contr., Jno. Ford, Newton, Kan.

Water Supply.—Well, pumping to tank.

Pumping Machinery.—Dy. cap., about 150,000 galls.; from U. S. Wind Engine & Pump Co., Batavia, Ill.

Tank.—Cap., 35,000 galls.

Distribution.—(In '88.) *Mains*, 5-in., ½ mile. *Taps*, 27. *Meters*, none. *Hydrants*, 7.

Consumption, 5,000 galls. *Pressure*, 125 lbs.

Financial – (In '88.) Cost, $7,000. Bonded debt, $6,000. Int., 6%. Ann. op. exp., $100. Ann. rev.: consumers, $150.

Management.—Chn. Com., Robt. Ratliff. Supt., J. M. Ammon.

VALLEY FALLS, *Jefferson Co.* (Pop., est., 1,600.) On Delaware river. Has good water-power used in manufacturing. No sewers. Has electric lights.

History.—Built in '88 by city for fire protection, but now being used for domestic purposes. Engrs. and Contrs., U. S. Wind Engine & Pump Co., Batavia, Ill.

Water Supply.—Wells pumping to tank. First well is 16 ft. in diam., 30 ft. deep and 300 ft. from Delaware river. Second well has same dimensions, and is 250 ft. from first.

Pumping Machinery.—Dy. cap., 18,000 galls.; make not given; 5 x 18-in.; driven by 30-ft. wind-mill.

Tank.—Cap., 70,000 galls.; 20 x 30 ft.; on 35-ft. stone tower, bottom of tank being 105 ft. above main street.

Distribution.—*Mains*, 6 and 4-in. c. i., 3-in. w. i., 2 miles. *Services*, not given. *Taps*, 16. *Meters*, none. *Hydrants*, kind not given, 13.

Consumption, 2,000 galls. *Pressure*, not given.

Financial.—Cost, $15,800. Bonded debt, $15,000. Int., 7%. Ann. op. exp., nominal. Ann rev.: consumers, $128.

Management.—Mayor, A. D. Kindall. City Clerk, H. D. Butts.

WEIR, *Cherokee Co.* (Pop., est., 3,000.) Engaged in mining coal and manufacturing zinc. Incorp. city of second class.

History.—Built in '89 by Weir City Water-Works Co., under 25-years franchise with privilege of renewal; put in operation Oct. 1.

Water Supply.—Artesian well, pumping to tank and direct. No filtration.

Pumping Machinery.—Dy. cap., 750,000 galls.; Smith & Vaile.

Tank. Cap., about 50,000 galls.; 22 x 18 ft.

Distribution.—*Mains*, 8 to 4-in. iron, 2½ miles. *Services*, ¾-in. iron. *Taps*, 60. *Meters*, none. *Hydrants*, 18.

Consumption, 50,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 200 lbs.

Financial —Cost, withheld, est., $35,000. Cap. stock, debt and int., withheld. Hydrant rental, $60 for $16, $50 for balance.

Management.—Prest., B. F. Hobart, Bank of Commerce Building, St. Louis, Mo. Secy., W. P. Heath. Treas., A. B. Cockerill. Report, about Feb. 10, '90.

WELLINGTON, *Sumner Co.* (Pop., 2,694; est., 10,000.) Incorp. city of second class. No sewers. Has electric lights.

History.—Built in '84-5 by Wellington Water Co., under 20-years franchise. Engr., C. W. Hill. Works were sold under foreclosure, Mar. 4, '89, former bondholders becoming stockholders, and named changed to Wellington Water-Works Co. Extended in '89; Chf. and Rest. Engr., Wm. Brown; Consult. Engr., J. Herbert Shedd; both of Providence, R. I.

Water Supply.—Slate creek, filtered, pumping from settling basin to tank, stand-pipe, and direct.

Settling Basin.—Is 200 ft. sq.

Pumping Machinery.—Cap., not given; two Smith & Vaile with original cap. of 750,000 galls.; 1,000,000 Worthington comp., cond., added in '89.

Filters.—Downward filtration, through gravel and sand.

Tank.—Dy. cap., not given; elevated.

Stand-Pipe.—Cap., 155,000 galls.; 24x105 ft.; from Riter & Conley, Pittsburgh, Pa.

Distribution.—*Mains*, c. i., 5 miles. *Services*, galv. i. *Taps* (in '87), 400. *Meters*, 2. *Hydrants*, kind not given, 64.

Consumption, 200,000 galls. *Pressure*, 45 to 100 lbs.

Financial.—Cost, withheld; est. cost of construction, $75,000. Cap. stock, authorized and issued, $100,000. Debt, none; $60,000 of bonds authorized, but none issued. Ann. op. exp., withheld, est., $3,000. Ann. rev.: consumers, $6,000; city, $3,700. Hydrant rental, $60 for 50, $50 for additional. Cost in '85 reported as $110,000. Cap. stock (in '88), $100,000. Bonded debt, at time of foreclosure, $100,000; at reorganization former bondholders became stockholders.

Management.—Prest., Chas. Perry, Jr., Westerly, R. I. Secy. and Treas., A. L. Chester. Supt., J. M. Thralls.

WICHITA, *Sedgwick Co.* (Pop., 4,911; est., 35,000.) At confluence of Big and Little Arkansas rivers on level ground. Engaged in manufacturing, and important railroad center. Settled in '72. Incorp. city. Has sewers and electric lights.

History.—Built in '82 by Wichita Water Co., which is owned by American Water-Works & Guarantee Co., Ltd., Pittsburgh, Pa. A 21-year franchise. Des. Engr., J. A. Jones.

Water Supply.—Ninety-six driven wells, pumping to stand-pipe and direct. Wells 4 ins. in diam., 35 ft. deep.

Pumping Machinery.—Dy. cap., 12,000,000 galls.; 5,000,000 Gaskill comp., cond., dup., high-pressure; 3,000,000 Walker, crank and fly-wheel; 1,000,000 Deane; 3,000,000 Smith & Vaile.

Stand-Pipe.—Is 2½ x 150 ft.; plate-iron.

Distribution.—*Mains*, c. i., Wyckoff, 28 miles. *Services*, galv. i. *Taps*, 1,500. *Meters*, none. *Hydrants*, Ludlow, White, 200.

Consumption, 2,000,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 90 lbs.

Financial.—Cost, withheld, est., $400,000. Cap. stock (in '88), $500,000. Bonded debt (in '88), $350,000. Int., not given. Ann. op. exp., withheld, est., $10,000. Ann. rev.: total, withheld, est., $50,000. Hydrant rent, $50.

Management.—Prest., J. H. Purdy. Secy., R. D. Barnes. Treas., S. M. Highlands. Supt., F. C. Armsbury.

WINDOM, *McPherson Co.* (Pop., est., 400.) Incorp. city. No sewers or electric lights.

History.—Built in '88 by city. Contrs., U. S. Wind Engine & Pump Co., Batavia, Ill.

Water Supply.—Well, pumping to tank.

Pumping Machinery.—Dy. cap., 150,000 galls.; Curtis double-acting, driven by windmill.

Tank.—Cap., 40,000 galls.

Distribution.—*Mains*, 4 in. kal. i., 1 mile. *Services*, i. *Taps*, 7 *Meters*, none. *Hydrants*, kind not given, 3.

Consumption, 1,000 galls. *Pressure*, not given.

Financial.—Cost, $7,000. Bonded debt, $5,000; other indebtedness, $900. Int., 6%. No op. exp. Ann. rev.: consumers, $200. Hydrant rental, $50.

Management.—Mayor, Jno. A. Hill. Secy., J. H. Baker.

WINFIELD, *Cowley Co.* (Pop., 2,844; est., 8,000.) On Walnut river. Settled in '70; incorp. city in '75. No sewers. Has electric lights.

History.—Built in '83 by Winfield Water Co., under 99-years franchise. Des. Engr., D. McN. Stauffer, N. Y. City. Const. Engr., Frank Barclay, Beatrice, who has also been Const. Engr. of late improvements.

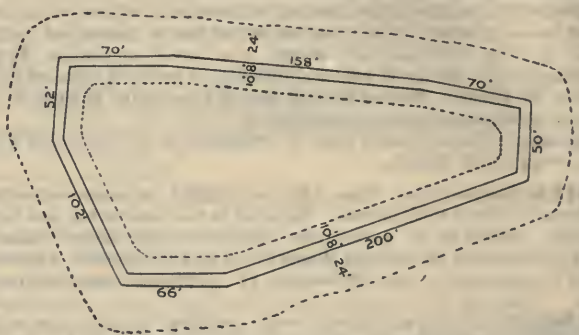
Water Supply.—Walnut river, pumping to reservoir, suction pipe extending from crib in river to pump-well. New suction pipe, further up river, projected in '89; wood, 18-in., 1,350 ft. long.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; Worthington comp. *Boilers:* steel; from Jno. O'Brien.

Filter.—Dy. cap., 1,000,000 galls.; Olyphant; built in '89.

Reservoir.—Cap., 1,750,000 galls.; 9 ft. of water. See accompanying plan. One mile from, 125 ft. above, main street. Built to conform to top of hill; latter rises 75 ft. above surrounding land. Originally about equally in excavation and embank-

ment, excavation carried to rock; had limestone walls in cem., 12 ft. high, 8 ft. thick at bottom, 3½ ft. at coping. Leaked badly, and ice giving trouble in winter inner sides of walls were banked with well-tamped clay, sloping 1 to 1; outer sides also banked with clay, sloping 2 to 1. Inner slopes and bottom covered with 6 ins. of concrete, paved with hard-burned bricks, laid flat; whole grouted with cem., and covered coat of same. *Discharge-pipe:* 12-in. Does not leak since alterations. Built in 83. Engr., Frank Barclay, Beatrice. Contr., Jas. Connor, Winfield. Cost, $12,500.



Plan of Reservoir, Winfield, Kan.

Distribution.—*Mains*, c. i., 9 miles. *Services*, galv. i. Pipe and specials from Dennis Long & Co., Louisville, Ky.; trenching and pipe-laying done by Jno. Maxwell. *Taps*, 400. *Meters*, kind not given, 12. *Hydrants*, Flower, 73. *Valves*, Flower.

Consumption, 100,000 galls. *Pressure:* Ordinary, 53 lbs. Fire, 120 lbs.

Financial.—Cost, withheld, est., $150,000. Cap. stock, $150,000. Bonded debt, $75,000. Int., 6%. Ann. op. exp. (in '87), $3,500. Ann. rev.: consumers (in '87), $8,300; city, $4,885. Hydrant rental, $75 and $65; 21 years contract.

Management.—Prest., Chas. H. Payson, Portland, Me. Secy., Treas. and Mgr., J. H. Decker, Salina.

WYANDOTTE, *Wyandotte Co.* See Kansas City, Mo.

Water-Works Projected with Fair Prospects of Construction.

BAXTER SPRINGS, *Cherokee Co.* (Pop., 1,177; est., 1,800.)

Proposed Works.—Franchise granted in '89, but was forfeited. Feb. 8, '90, proposals for franchise were wanted. Supply, river, ¼ mile distant, pumping to standpipe. Dam already built which would furnish water-power. Est. cost, $25,000. Comr., H. E. Crowell.

OSAGE CITY, *Osage Co.* (Pop., 2,098; est., 4,000.) Has deposits of coal, ochre and quarries of flagging stone. Incorp. city.

Proposed Works.—Feb. 9, '90, franchise had recently been granted, under which construction was to begin by Feb. 27. Mayor, W. B. Artz.

PHILLIPSBURGH, *Phillips Co.* (Pop., 309; est., 1,500.)

Proposed Works.—City to build in '90. Address G. W. Bickford, G. W. Young, or R. A. Hardy. Report, Oct. 11, '90.

RICHFIELD, *Morton Co.* (Pop., est., 1,200.)

Present Supply.—Two artesian wells, owned by town; no pipe has been laid, and as yet water is used for irrigation, only. Mayor, W. C. Burchsted.

Proposed Works.—Above may possibly be developed, but nothing definite reported up to Sept., '89.

WALLACE, *Wallace Co.* (Pop., 340; est., 600.)

Proposed Works.—Wallace Water-Works Co. organized in '87 and was in existence in '89, but had not built works June 1, '89. Prest., H. A. Clark.

Water-Works Projects Reported in '89 and 90, but Now Indefinite.

Horton, Brown Co. *Meade*, Meade Co. *Russell Springs*, Logan Co.; works described in MANUAL for '88, p. 442, were not built.

NEBRASKA.

Water-Works Completed or in Process of Construction.

ALBION, *Boone Co.* (Pop., 330; est., 1,500.) No sewers or electric lights.

History.—Built in '87 by town. Engr. and Contr., A. L. Strang, Omaha.

Water Supply.—Source not given, pumping from reservoir to tank and direct. Water was taken from wells until they failed.

Reservoir.—Cap., about 30,000 galls.

Pumping Machinery.—Dy. cap., 575,000 galls.; make not given; power for pumping furnished by engine at L. Clark's elevator.

Force Main.—Length, 1 mile.

Tank.—Cap., 55,000 galls.

Distribution.—*Mains*, 6 and 4-in. c. i., 1¼ miles. *Services*, not given. *Taps*, 9. *Meters*, none. *Hydrants*, Eclipse, 9.

Consumption, 2,000 galls. *Pressure:* Ordinary, 50 lbs. Fire, 120 lbs.

Financial.—Cost, $9,500. Bonded debt, $5,000. Int., not given. Ann. op. exp., $300. Ann. rev.: consumers, $100; city, $200.

Management.—Comr., H. P. Bull.

ASHLAND, *Sanders Co.* (Pop., 978; est., 1,800.) On Saline river. Incorp. No sewers. Has electric lights.

History.—Built in '87-8 by village.

Water Supply.—Two wells 70 ft. deep, pumping to tank.

Pumping Machinery.—Dy. cap., 500,000 galls.; Deane and Cook. *Boiler*: steel, return flue.

Tank.—Cap., 65,000 galls.

Distribution.—*Mains*, c. i., 3¼ miles. *Services*, galv. i., lead. *Taps*, 75. *Meters*, none. *Hydrants*, Galvin, 27.

Consumption, 16,000 galls. *Pressure*, 115 lbs.

Financial.—Cost, $19,000. Bonded debt, $19,000. Int., 6%. Ann. op. exp., $1,150. Ann. rev.: consumers, $520.

Management.—Mayor, D. C. Hawley. Secy. and Supt., A. H. Gould.

AURORA, *Hamilton Co.* (Pop., 1,232; est., 1,800.) Incorp. No sewers or electric lights.

History.—Built in '88-9 by town. Des. Engr., W. Kiersted, Kansas City, Mo. Const. Engr., L. D. May. Contr. for labor, Geo. W. Daniels, Aurora.

Water Supply.—Wells, pumping to reservoir, stand-pipe and direct. Wells were sunk by Cook Well Co., St. Louis, Mo.

Pumping Machinery.—Dy. cap., 750,000 galls.; Deane; two well pumps were furnished by Cook Well Co.

Reservoir.—Cap., 93,000 galls.

Stand-Pipe.—Cap., 63 000 galls; from Porter Mfg. Co., Syracuse, N. Y.

Distribution.—*Mains*, 10 to 6-in. c. i., 2½ miles; from Chattanooga (Tenn.) Foundry & Pipe Co. *Services*, not given. *Taps*, 56. *Meters*, none. *Hydrants*, Adams, 28.

Consumption, 24,800 galls. *Pressure:* Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—Cost, $27,000. Bonded debt, $27,000. Int., 6%. Ann. op. exp., $1,200. Ann. rev., not determined.

Management.—City Clerk, Wm. P. Hellings. Supt., H. G. Cass.

BEATRICE, *Gage Co.* (Pop., 2,447; est., 10,000.) On Big Blue river. Has water-power and several manufactories. Incorp. Has sewers and electric lights.

History.—Built in '86 by city. Contrs., Holly Mfg. Co., Lockport, N. Y.

Water Supply.—Big Blue river, filtered, direct pumping from reservoir.

Reservoir.—Cap., not given; about 300 ft. from river, water flowing to it by gravity.

Filters.—Dy. cap., 1,000,000 galls.; two, each 10 ft. in diam.; from Jewell Pure Water Co.; built in '89.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two 1,500,000 Gaskill horizontal, cond., a simple and a comp.

Distribution.—*Mains*, c. i., 7 miles. *Services*, not given, *Taps*, 325. *Meters*, kind not given, 3. *Hydrants*, Holly, 77. *Valves*, Eddy.

Consumption, 500,000 galls. *Pressure:* Ordinary, 50 lbs. Fire, 100 lbs.

Financial.—Cost (in '87), $80,000. Bonded debt, $80,000. Int., 6%. Ann. op. exp., $4,000. Ann. rev.: consumers, $4,250; city, $4,000.

Management.—Comr., W. A. Wagner.

BLAIR, *Washington Co.* (Pop., 1,317; est., 3,000.) Incorp. No sewers. Has electric lights.

History.—Built in '86 by town. Des. Engr., F. W. Felton, Omaha. Const. Engr., Geo. Sutherland, Blair. Contrs., Fairbanks & Co., St. Louis, Mo.

Water Supply.—Thirty 2-in. tube wells, pumping to reservoirs.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Smith & Vaile.

Reservoirs.—Cap., 700,000 galls.; three; one 53x100 ft.,x16 ft. deep and two each 38 ft. in diam., 16 ft. deep; of puddled clay. Inner slope, 1½ to 1, lined with brick and faced with Portland cem. Built in '88. Des. Engr., L. M. D. Vaughan. Const. Engr., E. Costello. Contr., H. Shields. Cost, $1,900.

Distribution.—*Mains*, c. i., 4 miles. *Services*, galv. i. *Taps*, 138. *Meters*, 1. *Hydrants*, kind not given, 23.

Consumption, 50,000 galls. *Pressure*, 100 lbs.

Financial.—Cost, $23,000. Debt. $20,000. Int., 7%. Ann. op. exp., $2,000. Ann. rev.: consumers, $1,000.

Management.—Supt., J. S. Cook. Report by J. R. Smith.

BROKEN BOW, *Custer Co.* (Pop., est., 3,000.) Incorp. No sewers or electric lights.

History.—Built in '88-9 by Broken Bow Water-Works Co., under 20-years franchise. Engr., Geo. W. Sturtevant, Minneapolis, Minn. Contr., C. A. Weeks, Broken Bow.

Water Supply.—Ten wells, each 100 ft. deep, pumping to reservoir. Water in wells rises nearly to surface.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Worthington. *Boiler:* 60-H. P.

Reservoir.—Cap., 1,250,000 galls.

Distribution.—*Mains*, 10 to 4-in. c. i., 3.1 miles. *Hydrants*, Holyoke, 34. *Valves*, Peet.

Consumption, not determined. *Pressure*, from reservoir, 70 lbs.

Financial.—Cost, $35,000. Cap. stock, $50,000. Bonded debt, $25,000. Int., 7%. Hydrant rental, $85 for 150, $75 for additional.

Management.—Prest., Jno. Reese. Secy., O. J. Collman. Supt., Geo. W. Sturtevant, Minneapolis, Minn.

CENTRAL CITY, *Merrick Co.* (Pop., 618; est., 2,000.)

General Description.—Built in '88 9 by village. Contr., Ben. S. Clarke, Holredge. Water is pumped by a 1,000,000-gall. Gordon & Maxwell to stand-pipe built by E. E. Palmer & Son, Kansas City, Mo. Est., cost, $20,000. Mayor, Wm. Patterson. No report could be obtained for '89.

CHADRON, *Dawes Co.* (Pop., est., 3,200.) Incorp. city. No sewers or electric lights.

History.—Built in '88-9 by town. Consult. Engr., A. A. Richardson, Lincoln, Neb. Const. Engr., P. M. Pritchard.

Water Supply.—Chadron creek, 3 miles distant, pumping to reservoir.

Pumping Machinery.—Dy. cap , 1,500,000 galls.; two Gaskill dup., one 1,000,000 and one 500,000.

Reservoir.—Cap., 1,000,000 galls.; 100 ft. in diam.; 192 ft. above city, which is one mile distant.

Distribution.—*Mains*, kind not given, 7 miles. *Taps*, 130. *Meters*, none. *Hydrants*, 33.

Consumption, 200,000 galls. *Pressure*, 120 lbs.

Financial.—Cost, $39,000. Bonded debt, $39,000. Int., 7%.

Management.—Comr., D. Y. Mears.

COLUMBUS, *Platte Co.* (Pop., 2,141; est., 4,000.) At junction of Platte and Loup rivers. Has electric lights.

History.—Built in '86-7 by town. Des. Engrs., House & Kiersted, Omaha. Const. Engr. and Contr., Chas. Schroeder, Columbus.

Water Supply.—Sixteen 3-in. driven wells, pumping to stand-pipe and direct.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; Smith & Vaile. *Boiler:* Brownell, from Fairbanks & Co., St. Louis, Mo.

Stand-Pipe.—Cap., 80,000 galls.; 12 x 100 ft.; iron; from E. E. Palmer & Son, Kansas City, Mo.

Distribution.—(In '87.) *Mains*, c. i., 3 miles. *Services*, galv. i., lead. Pipe and specials from Ripley & Kimball, St. Louis, Mo. *Taps*, 70. *Meters*, none. *Hydrants*, kind not given, 26.

Consumption, 200,000 galls. *Pressure:* Ordinary, 40 to 45 lbs. Fire, 100 to 125 lbs.

Financial.—(In '87.) Cost, $25,000. Debt, not given. Int., 6%. Ann. op. exp., $1,500. Ann. rev.: total, $2,000.

Management.—(In '88.) Comr., O. L. Baker. Pumpg. Engr., Wm. Rouston.

NOTE.—No report for '89 could be obtained.

CRETE, *Cherry Co.* (Pop., est., 2,800.) On Big Blue river. Has manufactories. Incorp. No sewers. Has electric lights.

History.—Built in '88-9 by A. L. Strang, Omaha, under 25-years franchise. Des. Engr., Andrew Rosewater, Omaha.

Water Supply.—System of wells, pumping to reservoir.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Worthington.

Reservoir.—Cap., 1,000,000 galls.

Distribution.—*Mains*, 12 to 6 in., 4.36 miles. *Hydrants*, 50.

Financial.—Est. cost, $35,000. Hydrant rental, $60.

Management.—Prest., Jno. R. Johnston. Secy., Geo. D. Stevens. Treas., F. A. Hobbs. Supt., Frank McConnell.

CULBERTSON, *Hitchcock Co.* (Pop., 701; est., 1,500.) At junction of Republican and Frenchman rivers. No sewers or electric lights.

History.—Built in '88-9 by town. Engrs. and Contrs., S. K. Felton Co., Omaha.

Water Supply.—Tube well, pumping to tank.

Pumping Machinery.—Dy. cap., unknown; driven by windmill.

Tank.—Cap., about 90,000 galls.; 20 x 30 ft.; on elevation.

Distribution.—*Mains*, 6 and 4-in. c. i., 3,000 ft. *Taps*, 25. *Meters*, none. *Hydrants*, Eclipse, Chapman, 7.

Consumption, 1,000 galls. *Pressure*, 50 lbs.

Financial.—Cost, $5,840. Debt., $6,000. Int., 7%. No op. exp. Ann. rev.: consumers, $200.

Management.—Village clerk, L. E. Crews.

DAVID CITY, *Butler Co.* (Pop., 1,000; est., 3,000.) Incorp. city. Has sewers and electric lights.

History.—Built in '88-9 by city. Des. Engr., A. A. Richardson, Lincoln. Const. Engr. and Contr., Chas. Schroeder, Columbus.

Water Supply.—Two Cook wells, pumping to stand-pipe and direct.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Buffalo; Cook pumps for wells. Main pump and boilers furnished by Pond Engineering Co., St. Louis, Mo.

Stand-Pipe.—Cap., 80,000 galls.; 12 x 100 ft.

Distribution.—*Mains*, c. i., 3 miles. Pipe and specials from Ohio Pipe Co., Columbus, O. *Meters*, none. *Taps*, 40. *Hydrants*, Tamaqua, 22. *Valves*, Peet.

Consumption, not determined. *Pressure:* Ordinary, 45 lbs. Fire, 100 lbs.

Financial.—Cost, $22,000. Bonded debt, $22,000. Int., 5%.

Management.—Comr., W. T. Richardson.

EDGAR, *Clay Co.* (Pop., 577; est., 2,000.) Incorp. city. No sewers or electric lights.

History.—Built in '88-9 by town. Des. Engr., A. A. Richardson, Lincoln. Contr., Ben. S. Clarke, Holdredge.

Water Supply.—Source not given, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 125,000 galls.; from Cook Well Co., St. Louis, Mo.

Stand-Pipe.—Cap., not given; from E. E. Palmer & Son., Kansas City, Mo.

Distribution.—*Mains*, 2 miles. *Taps*, 40. *Meters*, none. *Hydrants*, 20.

Consumption, 1,500 galls.

Financial.—Cost, $14,000. Debt, $13,000. Int., 6%. Ann. op. exp., est., $750.

Management.—Mayor, T. B. McClellan. Supt., J. J. Rogers.

FAIRBURY, *Jefferson Co.* (Pop., 1,251; est., 4,000.) Has flour mills and machine shops.

History.—Built in '88-9 by Fairbury Water-Works Co., under 25-years franchise; completed Feb. 1. Const. Engr., C. F. McLain, Omaha. Contr., A. L. Strang, Omaha.

Water Supply.—Wells, pumping to stand-pipe; Blue river in case of fire.
Pumping Machinery.—Dy. cap., 2,000,000 galls.; two 1,000,000 Knowles dup., a comp. and a high-pressure.
Stand-Pipe.—Cap., 84,000 galls.; 12 x 100 ft.
Distribution.—*Mains*, 12 to 4-in. c. i., 5.7 miles; from Shickle, Harrison & Howard Iron Co., St. Louis, Mo. *Services*, lead, iron. *Hydrants*, Chapman, 63. *Valves*, Chapman.
Financial.—Cost, withheld, est., $75,000. Cap. stock, $75,000. Bonds, $50,000. Hydrant rental, about $50.
Management.—Prest., F. L. Buck. Secy., C. F. McLain, Omaha.

FALLS CITY, *Richardson Co.* (Pop., 1,583; est., 2,600.) Incorp. No sewers or electric lights.
History.—Built in '88 by city. Engr., W. Kiersted, Kansas City, Mo. Contr., S. K. Felton, Omaha.
Water Supply.—Ground water, pumping to stand-pipe.
Pumping Machinery.—Dy. cap., 360,000 galls.; Knowles dup., non-comp., non-cond. *Boilers:* Haxteen.
Stand-Pipe.—Cap., about 85,000 galls.; 12½ x 100 ft.; from Shickle, Harrison & Howard Iron Co., St. Louis, Mo.
Storage Reservoir.—Cap., 185,000 galls.
Distribution.—*Mains*, 10 to 4-in. c. i., 3 miles. Pipe and specials from Shickle, Harrison & Howard Iron Co.; trenching and pipe-laying done by S. K. Felton, Omaha. *Taps*, 51. *Meters*, 5. *Hydrants*, Eclipse, 24. *Valves*, Ludlow.
Consumption, 50,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 100 to 140 lbs.
Financial.—Cost, $26,000. Bonded debt, $25,000: $10,000 at 6, $15,000 at 5%. Ann. op. exp., est., $2,250. Ann. rev.: consumers (for 4 months), $610.
Management.—City Clerk, P. M. Halsey.

FREMONT, *Dodge Co.* (Pop., 3,013; est., 8,000.) One mile from Platte river. No sewers. Has electric lights.
History.—Built in '85-6 by city. Engr., Geo. C. Morgan, Chicago, Ill. Important extensions made in '89. Contrs., National Iron & Brass Works, Dubuque, Ia.; contract price, about $30,000.
Water Supply.—Driven wells, pumping to stand-pipe and direct.
Pumping Machinery.—Dy. cap., 2,250,000 galls.; Deane high-pressure, 1,500,000 Smedley comp., cond., dup., added in '89.
Stand-Pipe.—Cap., 30,000 galls.
Distribution.—*Mains*, c. i., 5 miles. *Services*, iron, lead. *Taps*, 80. *Meters*, none. *Hydrants*, kind not given, 44.
Consumption, 75,000 galls. *Pressure:* Ordinary, 43 lbs. Fire, 100 lbs.
Financial.—Cost, $33,000. Debt, $28,000. Int., 6%. Ann. op. exp., $2,000. Ann. rev.: consumers, $1,400.
Management.—Comr., Geo. Marshall.

GENEVA, *Fillmore Co.* (Pop., 376; est., 1,000.) On Turkey creek.
History.—Contracts let in Sept., '89, by city. Engr., A. A. Richardson.
Water Supply.—Two Cook wells, about 200 ft. deep, pumping to stand-pipe.
Pumping Machinery.—Dy. cap., 1,000,000 galls.; Gaskill. *Boilers:* two. All from Pond Engineering Co., St. Louis, Mo.
Stand Pipe.—Cap., 93,000 galls.; 12 x 110 ft., from Jno. Harris.
Distribution.—*Mains*, 8 to 4-in. c. i., length not given. *Hydrants*, Tamaqua, number not given.
Financial.—Bonds voted, $23,000.
Management.—City Clerk, J. D. Hamilton.
NOTE.—Above subject to correction, as report was made just after letting of contracts.

GRAND ISLAND, *Hall Co.* (Pop., 2,963; est., 12,000.) Railroad and manufacturing center. Incorp. Sewers were to be built in '89. Has electric lights.
History.—Built in '86 by city. Des. Engr., A. A. Richardson. Constr. Engr. and Contrs., A. L. Strang Co., Omaha.
Water Supply.—Thirty-six 2-in. driven wells, pumping to stand-pipe and direct.
Pumping Machinery.—Dy. cap., 2,000,000 galls.; two 1,000,000 Knowles.
Stand-Pipe.—Cap., 80,000 galls.; 12x100 ft.

Distribution.—*Mains*, 10 to 4-in. c. i., 14½ miles. *Services*, lead Pipe and pecials from Dennis Long & Co., Louisville, Ky. *Taps*, 238. *Meters*, Crown, 4. *Hydrants*, Chapman, 75. *Valves*, Chapman.

Consumption, 500,000 galls. *Pressure:* Ordinary, 48 lbs. Fire, 140 lbs.

Financial.—Cost, $75,000. Debt, $75,000: $5,000 floating at 7, $70,000 bonded at 6%. Sinking fund. $1,630. Ann. op. exp., $4,000. Ann. rev.: consumers, $5,300; city (from taxes), $8,400.

Management.—Comr., Geo. Loan. Sr.

GRANT, *Perkins Co.* (Pop., est., 500.) Incorp. village. No sewers or electric lights.

History.—Built in '89 by Lincoln Land & Townsite Co., Lincoln; put in operation Sept. 9. Des. Engr., C. H. Meeker. Const. Engr. and Contr., Ben S. Clarke.

Water Supply.—Wells, pumping to stand-pipe and direct.

Pumping Machinery.- Dy. cap., 50,000 galls.

Stand Pipe.—Cap., 96,000 galls.; from W J. Cooper and Cole Bros.

Distribution.—*Mains*, 4-in. c. i., 3 miles. *Services*, ¾-in. galv. i. *Taps*, 40, *Meters*, none. *Hydrants*, Eclipse, 15. *Valves*, Arthur.

Pressure: Ordinary. 40 lbs. Fire, 160 lbs.

Financial.—Cost, est., $15,000. Int., 6%. Hydrant rental, $60.

Management.—Secy., R. O. Phillips, Lincoln. Latest report, Sept. 17, '89.

HASTINGS, *Adams Co.* (Pop., 2,817; est., 12,000.) Engaged in manufacturing. Incorp. city No sewers. Has electric lights.

General Description.—Built in '86-7 by city. Contrs., A. L. Strang Co., Omaha.

Water Supply.—Tubular wells, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 1,250,000 galls.; make not given.

Stand-Pipe.—No data.

Distribution.—*Mains*, kind not given, 16 miles. *Services*, not given. *Taps*, 680. *Meters*, kind not given, 5. *Hydrants*, kind not given, 84.

Consumption, 600,000 galls. *Pressure*, 125 to 180 lbs.

Financial.—Cost, $100,000. Debt, $100,000: $55,000 at 7, $15,000 at 5%. Ann. op. exp., $6,500. Ann. rev.: consumers, $7,500.

Management.—Comr., Aug. Rice.

HOLDREDGE, *Phelps Co.* (Pop., est., 3,200.) Has electric lights.

History.—Built in '88 by Holdredge Water Co., under 20-years franchise. Des. Engr., A. A. Richardson, Lincoln. Const. Engr. and Contr., Ben. S. Clarke, Holdredge.

Water Supply.—Two wells, pumping to reservoir and re-pumping to stand-pipe and direct. Wells are 200 ft. deep, with 60 ft. of water.

Pumping Machinery.—Dy. cap., 2,500,000 galls.; water raised from wells by two 12x36-in. vertical pumps, and is re-pumped by 1,500,000 high and 1,000,000-gall. low-pressure Buffalo. *Boilers:* from Pond Engineering Co., St. Louis, Mo., who also furnished pumps.

Receiving Reservoir.—Is 36x46 ft., x10 ft. deep.

Stand-Pipe.—Cap., 140,000 galls.; 15x110 ft.; from Excelsior Machine & Boiler Works, Chicago, Ill.

Distribution.—(In '87.) *Mains*, c. i., 4 miles. *Services*, galv. i., lead. Pipe and specials from Chattanooga (Tenn.) Foundry & Pipe Works. *Taps*, 50. *Meters*, none. *Hydrants*, Adams, 52. *Valves*, Ross.

Consumption not determined. *Pressure:* Ordinary, 80 lbs. Fire, 130 lbs.

Financial.—(In '87.) Cost, $62,000. Cap. stock, $32,000. Bonded debt, $30,000. Int., 5½%. Ann. op. exp., not determined. Ann. rev.: consumers, est., $4,000; city, $3,380. Hydrant rental, $65.

Management.—(In '88.) Prest., C. Thompson. Secy., Treas. and Mgr., Ben. S. Clarke.

NOTE.—No report for '89 could be obtained.

KEARNEY, *Buffalo Co.* (Pop., 1,728; est., 5,000.) Has manufactories. Has electric lights.

History.—Built in '87 by City Water Co., under 25-years franchise; managed by American Water-Works & Guarantee Co., Ltd., Pittsburgh, Pa.

Water Supply.—Driven wells and North Platte river, direct pumping.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; four Walker.

Distribution.—*Mains*, c. i., kal. i., 10 miles. *Services*, galv. i. *Taps*, 400. *Meters*, none. *Hydrants*, kind not given, 102.

Consumption, 400,000 galls. *Pressure*, not given.

Financial.—(In '87.) Cost $85,000. Cap. stock, $75,000. Bonded debt, $75,000. Int., 6%. Ann. op. exp., withheld, est., $3,500. Ann. rev.: consumers, withheld, est., $4,000; city, $3,000. Hydrant rental, $66.66.

Management.—Prest., S. M. Highlands. Secy., W. S. Kuhn, Pittsburgh, Pa. Supt., W. H. Cramer.

LINCOLN, *Lancaster Co.* (Pop., 13,003; est., 40,000.) Engaged in manufacturing and trade. Incorp. city. Has sewers and electric lights.

History.—Built in '85 by city.

Water Supply.—One surface and about 100 driven wells, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 4,500,000 galls.; three 1,500,000 Knowles dup. *Boilers:* 5 x 16 ft., horizontal, tubular.

Stand-Pipe.—Cap., 140,000 galls.; 18 x 75 ft.

Distribution.—*Mains*, c. i., 19 miles. *Services*, galv. i., lead. *Taps*, 1,400. *Meters*, 60. *Hydrants*, Mathews, 153. *Valves*, Ludlow, Galvin.

Consumption, 1,500,000 galls. *Pressure:* Ordinary, 45 lbs. Fire, 100 lbs.

Financial.—Cost, $150,000. Debt, $110,000. Int., 6%. Ann. op. exp., $16,673. Ann. rev.: consumers, $20,000.

Management.—Comr. and Supt., I. L. Lyman.

LONG PINE, *Brown Co.* (Pop., est., 700.)

History.—Built in '88 by village.

Water Supply.—Silver springs, pumping to tank. Seven springs, near Long Pine creek.

Pumping Machinery.—Dy. cap., 250,000 galls.

Tank.—Cap., 70,000 galls.; 75 ft. from Main St.

Distribution.—*Mains*, 6 and 4-in., 2½ miles. *Services*, ¾-in. *Taps*, 60. *Meters*, none. *Hydrants*, 12.

Consumption, 7,000 galls.

Financial.—Cost, $15,000. Bonded debt, $8,160. Int., 7 and 6%. Ann. op. exp., $550. Ann. rev.: consumers, $400.

Management.—Comr., City Clerk, W. J. Courtright. Report, May 7, '89.

LOUP CITY, *Sherman Co.* (Pop., est., 1,500.)

History.—Built in '87-8 by city. Des. Engr., A. A. Richardson, Lincoln. Const. Engr. and Contr., Chas. Schroeder, Columbus. Sub-contr., Ralph Richards, Loup City.

Water Supply.—Four 3 in. driven wells, pumping to reservoir and direct.

Pumping Machinery.—Dy. cap., 300,000 galls.; Buffalo; Pond Engineering Co., St. Louis, Mo.

Reservoir.—Is 46 ft. wide and 12 ft. deep.

Distribution.—(In '88.) *Mains*, c. i., 1½ miles. Pipe from Chattanooga (Tenn.) Foundry & Pipe Works, and Ohio Pipe Co., Columbus, O.; specials from J. C. Kilner, York. *Hydrants*, Tamaqua, 13. *Valves*, Galvin.

Pressure: Ordinary, 40 to 45 lbs. Fire, 100 lbs.

Financial.—(In '88.) Cost, about $10,000. Bonded debt, $8,000. Int., 6%.

Management.—Comr.

NOTE.—No report could be obtained for '89.

MADISON, *Madison Co.* (Pop., 417; est., 1,200.) Incorp. No sewers or electric lights.

History.—Built in '89 by city; put in operation in Aug. Engr., Geo. A. Latimer, Norfolk.

Water Supply.—Driven wells, 100 ft. deep, pumping direct and to tank.

Pumping Machinery.—Dy. cap. and make, not given. *Boiler:* 20-H. P., from Pond Engineering Co., St. Louis, Mo.

Tank.—Wood.

Distribution.—No data.

Financial.—Cost, $13,000. Bonds, authorized, $14,000. Int., 7%.

Management.—Secy., A. C. Tywell. [Supt., Jno. Hershaw. Latest report, about Mar 5, '90.

NEBRASKA CITY, *Otoe Co.* (Pop., 4,183; est., 10,000.) On Missouri river. Engaged in manufacturing and trade. Laid out in '54. Incorp. city. Has sewers and electric lights.

History.—Built in '87 by City Water Co., under 20-years franchise. Co. operates electric lights. Chf. Engr., S. H. Lockett, N. Y. City. Const. Engr., E. A. Rudiger, Supt. Contrs., Comegys & Lewis, N. Y. City, who sublet labor to local parties.

Water Supply.—Missouri river, pumping to settling basin, then repumped through filters to stand-pipe.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two 1,000,000 Worthington, comp., dup. *Boilers:* two 80-H. P., from Pond Engineering Co., St. Louis, Mo. A 500,000 Worthington contracted for in '89.

Settling Basins.—*Old:* cap., 700,000 galls. *New:* cap., 3,000,000 galls.; two of equal cap: built in '89 or '90.

Filter.—Dy. cap., 300,000 galls.; Hyatt.

Stand-Pipe.—Cap., about 85,000 galls.; 12½x100 ft.; top, 231 ft. above pumps; from Shickle, Harrison & Howard Iron Co., St. Louis, Mo.

Distribution.—(Jan. 1, '90.) *Mains*, 12 to 4-in., 8 miles. *Services*, not given. Pipe and specials from Shickle, Harrison & Howard Iron Co. *Taps*, 521. *Meters*, kind not given, 41. *Hydrants*, Ludlow, 82. *Valves*, Ludlow.

Consumption, 700,000 galls. *Pressure:* Ordinary, 100 lbs. Fire, 140 lbs.

Financial.—(Jan. 1, '90.) Cost, $200,000. Debt, $150,000. Int., 6%. Sinking fund, 2% after 10 years. Ann. op. exp., $5,500. Ann. rev.: consumers, $19,800; city, $4,000. Hydrant rental, $50.

Management.—Prest., Chas. Whann. Secy. and Treas., Chas. B. Ludwig, 72 Broadway, N. Y. City. Supt., J. S. Kennedy.

Reference.—For general description and illustrations of new storage reservoirs, built in '89, and giving way of same, see *Eng. News*, vol. xxiii., pp. 376-7.

NELICH, *Antelope Co.* (Pop., est., 1,500.) On Elkhorn river.

History.—Built in '87 by city. Engr., C. F. McLain. Contrs., A. L. Strang Co., Omaha.

Water Supply.—Elkhorn river, filtered, pumping to tank.

Pumping Machinery.—Dy. cap., 500,000 galls.; Knowles.

Filter.—No data.

Tank.—Cap., 50,000 galls.; 24 x 18 ft.; wooden.

Distribution.—*Mains*, 6 and 4-in. c. i., 2 miles. Pipe and specials from Shickle, Harrison & Howard Iron Co. *Services*, lead. *Taps*, 50. *Meters*, none. *Hydrants*, Eclipse, 15. *Valves*, Ludlow.

Consumption, not given. *Pressure*, 30 lbs.

Financial.—Cost, $10,500. Bonded debt, $10,000. Int., 6%. Ann. op. exp., $800. Ann. rev.: total (in '88), $800.

Management.—(In '88.) Comr., W.C. Estes. Secy., Fred. Thompton.

NORFOLK, *Madison Co.* (Pop., 1,216; est., 3,500.) Incorp. Has sewers and electric lights.

History.—Built in '88 by Norfolk Water-Works Co. Const. Engr., C. F. McLain, Omaha. Contrs., A. L. Strang Co., Omaha.

Water Supply.—Two 400-ft. artesian wells, pumping to stand-pipe. Connection is made with Elkhorn river for use in emergency.

Pumping Machinery.—Dy. cap., 2,300,000 galls.; two Knowles, one comp. and one high-pressure. *Boilers:* two, 60-H. P.

Stand-Pipe.—Cap., 80,000 galls.; 12 x 100 ft.; on elevation 60 ft. above business part of city.

Distribution.—*Mains*, 10 to 4-in. iron, 5 miles. *Services*, not given. *Taps*, 80. *Meters*, kind not given, 3. *Hydrants*, Chapman, 60. *Valves*, Chapman.

Consumption, 200,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 120 lbs.

Financial.—Cost (in '88), $35,000. Ann. op. exp., $1,800. Ann. rev.: consumers, $1,200; city, $3,000.

Management.—Controlled by A. L. Strang, Omaha. Supt., C. C. Voorhees.

NORTH PLATTE, *Lincoln Co.* (Pop., 363; est., 4,000.) Near junction of North and South Platte rivers. Has electric lights.

History.—Built in '87 by North Platte Water-Works Co., under 20-years franchise; managed by American Water-Works & Guarantee Co., Ltd., Pittsburgh, Pa. Contr., M. Walker, Fenton, Mich.

Water Supply.—Driven wells, 75 to 100 ft. deep, and North Platte river, pumping direct.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; two Walker.

Distribution.—*Mains*, 12 to 4-in. c. i., 4½ miles. *Services*, galv. i. *Taps*, 250. *Meters*, not given. *Hydrants*, Ludlow, 45. *Valves*, Ludlow.

Consumption, 300,000 galls; *Pressure*, 100 lbs.

Financial.—Cost, withheld, est., $100,000. Cap. stock, $125,000. Bonded debt, $75,000. Int., not given. Ann. op. exp., withheld, est., $2,000. Ann. rev.: consumers, withheld, est., $5,000; city withheld, est., $3,000. Hydrant rental, $65.

Management.—Prest., J. H. Purdy. Secy. and Treas., S. M. Highlands. Supt., Jas. Wilson.

OMAHA, *Douglas Co.* (Pop., 30,518; est., 120,000.) On Missouri river on 3 terraces: first a few feet above high water, and from 700 to 1,000 ft. wide; second from 17 to 70 ft. above high water, and from 1,000 to 7,000 ft. wide; third has undulating surface, rising in places to elevation of 250 ft. Founded in '55. Has electric lights.

History.—Built in '80-1 by private Co., under perpetual franchise, and now owned and operated by American Water-Works Co. South Omaha has been supplied since '88. Engr., J. D. Cook, Toledo, O. Chf. Const. Engr., Chester B. Davis, Chicago, Ill. Extensive improvements made in '88-9, consisting of pumping plant, settling basins and conduit.

Water Supply.—Missouri river, pumping to settling basins, thence repumped to city and to reservoir 306 ft. above river; repumped from latter for high service. First supply taken from river about one mile above main discharge sewer. New supply taken from river at Florence, 7 miles from city. Old station and settling basins used only in emergency.

Pumping Machinery.—Dy. cap. of all, 78,500,000 galls. Distribution by stations not given, but there are two Allis, 5,000,000 low-, 13,000,000 high-service; 7,500,000 Knowles; 5,000,000 and 15,000,000 Gaskill. *River: Pumps:* cap., 40,000,000 galls. *General Service:* cap., 27,500,000 galls. *High Service:* cap., 11,000,000 galls.

Settling Basins.—*Old:* settling cap., not given. Three, averaging 125 x 325 ft., x 10 ft. deep. Inner slopes, 2 to 1, lined with brick in cem. Used alternately. Water passes from these to clear water basin, 45 x 430 ft., x 10 ft. deep, from which it is pumped to reservoir.

New: dy. settling cap., 48,000,000 galls. Six basins, arranged so that water flows slowly from one to another, going from last to repumping plant. About ¾ miles from river.

Conduit.—Diam., 36 ins.; length, 6 miles.

Reservoir.—Cap., 11,000,000 galls.; two miles northwest of city in excavation and embankment; in two divisions, each 169 x 210 ft. at water surface, by 24 ft. deep. It is lined with 1 ft. of clay puddle, covered on the slopes with brick laid dry on edge, and on the bottom with 6 ins. of broken stone.

Distribution.—*Mains,* c. i., 111 miles. *Services,* lead. *Taps,* 4,862. *Meters,* kind not given, 650. *Hydrants,* Mathews, Holly, 1,102. *Pressure-recording gauge,* Edson.

Consumption, 10,000,000 galls. *Pressure,* 100 lbs.

Financial.—Cost, about $4,000,000. Bonded debt, $2,000,000. Int., 6%. Ann. op. exp., $68,000. Ann. rev.: consumers, $175,181; city, $54,872. Hydrant rental, $84 for first 250, $10 for 31, $60 for additional.

Management.—Prest., W. A. Underwood, Boston, Mass. Secy., W. H. Hall. Supt., A. B. Hunt.

ORD, *Valley Co.* (Pop., 491; est., 1,500.)

History.—Built in '87 by town. Engr. and Contr., S. K. Felton, Omaha.

Water Supply.—Driven wells, pumping to reservoir and direct.

Pumping Machinery.—Dy. cap., 750,000 galls.; Knowles. *Boiler:* from Porter Mfg. Co., Syracuse, N. Y.

Reservoir.—Cap., about 170,000 galls.

Distribution.—(In '88.) *Mains,* kal. i., 2¼ miles. *Services,* lead. Pipe and specials from Detroit (Mich.) Pipe & Foundry Co. *Taps,* 40. *Meters,* none. *Hydrants,* Eclipse, 14. *Valves,* Galvin.

Pressure: Ordinary, 60 lbs. Fire, 125 lbs.

Financial.—(In '88.) Cost, $14,000. Debt, $12,000. Int., 6%. Ann. op. exp., est., $1,000.

Management.—(In '88.) Chn. Water Board, Jno. W. Perry. Supt., Jno. L. York.

NOTE.—No report for '89 could be obtained.

ORLEANS, *Harlan Co.* (Pop., 970; est., 1,200.)

History.—Built in '88-9 by city. Engr., A. A. Richardson, Lincoln.

Water Supply.—Tubular well, pumping to tank.

Pumping Machinery.—Dy. cap., well-pump, 24,000 galls.; from Cook Well Co.

Tank.—Cap., 65,000 galls. Contrs., Metcalf & Co., Lincoln.

Distribution.—*Mains*, 8 and 7-in. c. i., 5,700 ft. *Services*, not given. Pipe and specials from Chattanooga (Tenn.) Iron & Pipe Foundry; trenching and pipe-laying done by Farrell & McDonough. *Hydrants*, 12

Financial.—Cost, $11,000. Debt, $8,500. Int., 6%.

Management.—City Council. Supt., R. R. Pate. Report by Jno. R. Kennedy; date, May 10, '89.

PAWNEE CITY, *Pawnee Co.* (Pop., 763; est., 3,000.)

History.—Built in '87-8 by city. Des. Engr., A. A. Richardson, Lincoln. Const. Engr., Chas. Schroeder, Columbus.

Water Supply.—Two 7-in. wells, pumping to stand-pipe and direct. Wells sunk by C. D. Dundas, Pawnee City.

Pumping Machinery. Dy. cap., 2,500,000 galls.; make not given.

Stand-Pipe.—Cap., 80,000 galls.; 12x100 ft.

Distribution.—(In '88.) *Mains*, c. i., 3½ miles. *Hydrants*, 28.

Pressure: Ordinary, 65 lbs. Fire, 125 lbs.

Financial.—(In '88.) Cost, $28,500. Debt, not given. Int., 6%.

Management.—City Clerk, J. M. Miller.

NOTE.—No report for '89 could be obtained.

PLATTSMOUTH, *Cass Co.* (Pop., 2,967; est., 7,500.) At confluence of Platte and Missouri rivers. Partially sewered. No electric lights.

History.—Built in '86-7 by Wisconsin Construction Co., Boston, under 20-years franchise; known locally as Plattsmouth Water Co. Des. Engr., J. D. Cook, Toledo, O. Const. Engr., C. W. Paine.

Water Supply.—Missouri river, pumping to stand-pipe.

Settling Basins.—Two; cap., 800,000 galls. each.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two Blake, one comp., and one simple dup. *Boilers:* two, 60-H. P., return, tubular.

Stand Pipe.—Cap., 285,000 galls.; 25 x 80 ft.; from Stacey Mfg. Co.

Distribution.—*Mains*, c. i., 5 miles. *Services*, rustless i. Pipe and special from Cincinnati & Newport Iron & Pipe Co., Newport, Ky. *Taps*, 275. *Meters*, 12. *Hydrants*, Chapman, 60. *Valves*, Chapman. *Pressure-recording gauge*, Edson.

Consumption, not given. *Pressure:* Ordinary, 80 lbs. Fire, 80 to 100 lbs.

Financial.—Cost, withheld, est., $100,000. Debt, not given. Ann. op. exp., withheld, est., $2,500. Ann. rev.: total, withheld, est., $10,000. Hydrant rental, $80.

Management.—Prest., A. B. Turner, Boston, Mass. Secy., M. D. Polk. Treas., J. Wentworth Brown, Boston, Mass. Supt., T. F. Coursey.

RANDOLPH, *Cedar Co.* (Pop., est., 400.) Incorp. village. No sewers or electric lights.

History.—Built in '89 by village. Contr., S. W. Mosher, Randolph.

Water Supply.—Tubular well, pumping to tank.

Pumping Machinery.—Dy. cap., about 2),000 galls.

Tank.—Cap., about 50,000 galls.

Distribution.—*Mains*, 4-in. c. i., 1 mile. *Services*, w. i. *Taps*, 40. *Hydrants*, 3.

Financial.—Cost, $2,800. Bonded debt, $2,800. Int., 7%.

Management.—Supt., J. C. Farley. Reports, Mar. 10 and 26, '90.

RED CLOUD, *Webster Co.* (Pop., 677; est., 3,500.) Incorp. city. No sewers. Has electric lights.

History.—Built in '87 by city. Des. Engr., Jno. W. Nier, Kansas City, Mo. Const. Engr., S. Jobe.

Water Supply.—Two surface wells, pumping to stand-pipe and direct.

Pumping Machinery.—Dy. cap., 250,000 galls.; Deane, comp., dup.

Stand-Pipe.—Cap., 70,000 galls.; 14 x 70 ft.; on elevation of 60 ft.; from H. C. Darby, Kansas City, Mo.

Distribution.—*Mains*, iron, 5 miles. *Services*, galv. i. Pipe and specials from Ripley & Bronson, St. Louis, Mo. *Taps*, 65. *Meters*, none. *Hydrants*, Mathews, 32. *Valves*, Eddy.

Consumption, 140,000 galls. *Pressure:* Ordinary, 56 lbs. Fire, 90 lbs.

Financial.—Cost, $29,000. Bonded debt, $20,000. Int., 6%. Ann. op. exp., $1,200. Ann. rev.: total, withheld, est., $1,300.

Management.—Comr., E. M. Perkins.

RIVERTON, *Franklin Co.* (Pop., 426; est., 700.) Incorp. No sewers or electric lights.

History.—Built in '88 by town. Engr., S. K. Felton, Omaha.

Water Supply.—Thompson creek, pumping to tank.

Pumping Machinery.—Dy. cap, 1,000,000 galls.; water-power; from Flennekin Turbine Co., Dubuque, Ia.

Tank.—Cap., 27,000 galls.; 16 x 18 ft.

Distribution.—*Mains*, kal. i., 2 miles. *Services*, w. i. *Taps*, 73. *Meters*, none. *Hydrants*, 8.

Consumption, 500,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 75 lbs.

Financial.—Cost, $8,500. Bonded debt, $4,300. Int., 7%. No op. exp. Ann. rev.: consumers, $300.

Management.—Town Board. Supt., Phil. Zieyle.

RUSHVILLE, *Sheridan Co.* (Pop., est., 800.)

History.—Built in '88 by village, for fire protection only. Engr. and Contr., S. K. Felton, Omaha. **Water Supply.**—Driven wells, pumping to tank. **Pumping Machinery.**—Dy. cap., not given; Curtis double-acting, driven by windmill. **Tank.**—Cap., 35,000 galls.; on elevation 50 ft. above town. **Distribution.**—*Mains*, c. i., 2,000 ft. *Taps*, 12. *Hydrants*, kind not given, 6. **Financial.**—Cost, $3,600. Debt, $3,500. Int., 7%. No op. exp. or rev. **Management.**—Chn. of Village Board, Jno. H. Jones.

SAINT PAUL, *Howard Co.* (Pop., 1,322; est., 2,000.)

History.—Built in '87-8 by town. Des. Engr., A. A. Richardson, Lincoln. Const. Engr. and Contr., Cha. Schroeder, Columbus.

Water Supply.—Thirty-two 2-in. driven wells, pumping to stand-pipe and direct.

Pumping Machinery.—Dy. cap., 750,000 galls; Buffalo. *Boiler:* Brownell. Both from Pond Engineering Co., St. Louis, Mo.

Stand-Pipe.—Cap., about 50,000 galls.; 12 x 60 ft.; iron; built by E. E. Palmer & Son, Kansas City, Mo.

Distribution.—*Mains*, c. i., 3½ miles. Pipe from Chattanooga (Tenn.) Foundry & Pipe Works, and specials from Jno. C. Kilner, York. *Hydrants*, 26.

Pressure: Ordinary, 30 to 40 lbs. Fire, 100 lbs.

Financial.—Cost, $22,000. Bonded debt, $20,000. Int., 6%.

Management.—Water Comr. Supt., C. Starkweather.

NOTE.—No report could be obtained for '89.

SEWARD, *Seward Co.* (Pop., 1,525; est., 2,500.) Incorp. city. No sewers. Has electric lights.

History.—Built in '88-9 by city; put in operation about May 1. Engr., A. A. Richardson, Lincoln. Labor done by city.

Water Supply.—Cook wells, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., not given; Cook deep-well pump and large pump from Pond Engineering Co., St. Louis, Mo. *Boiler:* from Brownell & Co., Omaha.

Stand-Pipe.—Cap., 93,000 galls.; 12 x 110 ft.; from Porter Jackson & Co., Chicago, Ill.

Distribution.—*Mains*, 10 to 4-in., c. i., 3¼ miles; from Shickle, Harrison & Howard Iron Co., St. Louis, Mo. *Hydrants*, 48.

Financial.—Cost, about $30,000. Bonded debt, $30,000. Int., 6%.

Management.—Reports by E. P. Philip and J. C. Mulfinger; dates, Oct. 22 to Mar. 3, '90.

SOUTH OMAHA, *Douglas Co.* See Omaha.

STROMSBURG, *Polk Co.* (Pop., 1,091; est., 2,000.) Manufactures carriages plows and brooms. Incorp. No sewers or electric lights.

History.—Built in '88-9 by town. Const. Engr. and Contr., Chas. Schroeder, Columbus. It was claimed that Contr. failed to comply with contract and contracts were relet, thus delaying completion of works.

Water Supply.—Cook wells, pumping to stand-pipe and direct.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; two 480,000 Buffalo. Pumps and boilers from Pond Engineering Co., St. Louis, Mo.

Stand-Pipe.—Cap., 22,000 galls.; 8 x 60 ft.

Distribution.—*Mains*, c. i., 2 miles. *Taps*, 20, *Meters*, none. *Hydrants*, Tamaqua, 16. *Valves*, Pect.

Pressure: Ordinary, 40 lbs. Fire, 110 lbs.

Financial.—Cost, $12,000. Bonded debt, $12,000. Int., 6%.

Management.—Mayor and Council.

NOTE.—Subject to corrections, as report was made before works was completed.

SUPERIOR, *Nuckolls Co.* (Pop., est., 2,500.) Incorp. No sewers. Has electric lights.

History.—Built in '88-9 by town. In '89 city gave franchise for electric lights, to be run in connection with water-works. Des. Engr., W. Kiersted, Kansas City, Mo. Const. Engr. and Contr., S. K. Felton, Omaha.

Water Supply.—Well, 25 ft. in diam., 30 ft. deep, by direct pumping.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; two Deane, one 1,000,000 high service, and one 500,000 comp., cond. *Boilers:* from Pond Engineering Co., St. Louis, Mo.

Distribution.—*Mains*, 10 to 4-in. c. i., 4 miles. *Services*, not given. *Taps*, 80. *Meters*, none. *Hydrants*, Chapman, 21. *Valves*, Chapman.

Consumption, not determined. *Pressure:* Ordinary, 40 lbs. Fire, 120 lbs.

Financial.—Cost, $27,000. Debt, $27,000. Int., 5%. Ann. op. exp., $2,000. Ann. rev.: consumers, $800. Hydrant rental, $12.60.

Management.—Chn. Com., Geo. Brown.

TECUMSEH, *Johnson Co.* (Pop., 1,268; est., 2,600.) On Big Nehama river, which affords water-power. Incorp. No sewers or electric lights.

History.—Built in '88-9 by town. Des. Engr., A. A. Richardson, Lincoln. Contr., Ben. S. Clarke, Holdredge.

Water Supply.—Source not given; pumping.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Cook.

Distribution.—*Mains*, 4 miles. *Taps*, 40. *Meters*, none. *Hydrants*, 30.

Consumption, 50,000 galls. *Pressure*, not given.

Financial.—Cost, $21,000. Debt, $21,000. Int., 6%. Ann. op. exp., $1,200. Ann. rev.: consumers, $1,000,

Management.—Clerk, P. A. Bundage. Engr., Wm. Reckeney.

VALPARAISO, *Saunders Co.* (Pop., 300; est., 700.) Has manufactories.

General Description.—Built in '88 by town. Des. Engr., A. A. Richardson, Lincoln. Water is pumped from well to 60,000-gall. reservoir. There are 2 miles of pipe and 10 hydrants. Est. cost, $15,000. Town Clerk, D. M. Deane.

NOTE.—No response to inquiries sent in '89.

WAHOO, *Saunders Co.* (Pop., 627; est., 4,400.) On Wahoo river. Settled in '76. Has electric lights.

History.—Built in '87 by Wahoo Water-Works Co., under 20-years franchise; managed by American Water-Works and Guarantee Co., Ltd., Pittsburgh, Pa.

Water Supply.—Driven wells and Wahoo river, by direct pumping.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; two Walker.

Distribution.—*Mains*, c. i., 6 miles. Pipe and specials from New Philadelphia (O.) Pipe Co.; trenching and pipe-laying done by M. Walker, Port Huron. *Taps*, withheld, est., 200. *Hydrants*, Ludlow, 43. *Valves*, Ludlow.

Consumption, 200,000 galls. *Pressure*, 60 to 120 lbs

Financial.—(In '88.) Cost, $63,000. Cap. stock, $125,000. Bonded debt, $60,000. Int., 6%. Ann. op. exp., withheld, est., $1,200. Ann. rev.: total, withheld, est., $6,000.

Management.—Prest., J. H. Punley. Secy. and Treas., S. M. Highlands. Supt., H. E. Kerr.

WEEPING WATER, *Cass Co.* (Pop., 317; est., 1,200.) On Weeping Water river. Manufactures lime.

History.—Built in '88 by town.

Water Supply.—Wells, pumping to reservoir.

Pumping Machinery.—Dy. cap., 550,000 galls; Knowles.

Reservoir.—Cap., 170,000 galls.; 140 ft. above main street.

Distribution.—*Mains*, 8 to 4 in. c. i., 2 miles. *Services*, not given. *Taps*, 75. *Meters*, none. *Hydrants*, kind not given, 33.

Financial.—Cost, $15,000. Debt, $13,000. Int., 6%. Ann. op. exp., est., $1,000. Ann. rev.: consumers, $750.

Management.—Comr. and Supt., C. C. Martin.

WEST POINT, *Cuming Co.* (Pop., 1,000; est., 2,000.) On Elkhorn river. Has water-power used in manufacturing. Incorp. No sewers. Has electric lights.

History.—Built in '88 by town. Engr., S. K. Felton. Contrs., A. L. Strang Co. Both of Omaha.

Water Supply—Wells, pumping to reservoir and direct. There are 24 2-in. driven wells, 30 ft. deep, connected at top.

Pumping Machinery.—Dy. cap., 2,016,000 galls.; two Knowles, one 864,000 water-power and one 1,152,000 steam dup. Use of water-power for pumping is leased to village for $500 a year.

Reservoir.—Cap., 110,000 galls.

Distribution.—*Mains*, kal. i., 4⅛ miles. *Services*, galv. i. *Taps*, 109, *Meters*, none. *Hydrants*, Ludlow, 34. *Valves*, Ludlow.

Consumption, 112,000 galls. *Pressure:* Ordinary, 85 lbs. Fire, 195 lbs.

Financial.—Cost (in '87), $14,800. Debt (in '87), $16,000. Int., 6%. Ann. op. exp., $1,000. Ann. rev.: consumers, $1,000.

Management.—Mayor. Wm. Stuefer. Secy., F. E. Kreuse.

WISNER, *Cuming Co.* (Pop., 282; est., 600.) On Elkhorn river.

History.—Built in '84 by town.

Water Supply.—Well, pumping to tank.

Pumping Machinery.—Dy. cap., not given. Pumping done by Wisner Roller Mills, who own plant. Windmill was formerly used, but was insufficient.

Tank.—Cap., about 90,000 galls.

Distribution.—*Mains*, kal. i., ½ mile. *Services*, galv. i. *Taps*, 20. *Meters*, none. *Hydrants*, kind not given, 6.

Consumption, not given. *Pressure*, 60 lbs.

Financial.—Cost, $4,600. Debt, $4,000. Int., 7%. Ann. op. exp., $200. Ann. rev.: consumers, $165; city, $165.

Management.—Comr. and Supt., N. Salsbury.

WYMORE, *Gage Co.* (Pop., est., 3,000.) Has railway repair shops. Incorp. city of second class. No sewers. Has electric lights.

History.—Built in '89-90 by city; put in operation about Apr. 30. Engr., A. A. Richardson, Lincoln.

Water Supply.—Wells, pumping to stand-pipe.

Pumping Machinery.—Dy. cap, 750,000 galls.; Buffalo. *Boilers:* from Porter Jackson & Co, Chicago, Ill.

Stand-Pipe.—Cap., 93,000 galls.; 12 x 112 ft.; from Porter Jackson & Co., Chicago, Ill.

Distribution.—*Mains*, 10 to 4-in. c. i., about 4½ miles. Pipe from So. St. Louis (Mo.) Foundry Co.; specials from York (Neb) Foundry. *Hydrants*, Adams, 51. *Valves*, Carr.

Financial.—Cost, about $30,000. Bonded debt, $30,000. Int., 5%. Ann. op. exp., est., $1,200.

Management.—Mayor, P. M. Hobbs. City Clerk, Geo. L. Hemperley. Latest report, Mar. 6, '90.

YORK, *York Co.* (Pop., est., 5,000.) Has electric lights.

History.—Built in '87-8 by York Water-Works Co. Engr., C. F. McLain. Contrs., A. L. Strang Co. All of Omaha.

Water Supply.—System of 6-in. Cook wells and connection with Beaver creek, pumping to stand-pipe and direct.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two Knowles, one 1,000,000 comp. and one 1,000,000 high-pressure.

Stand-Pipe.—Cap., 80,000 galls.; 12 x 100 ft.; on elevation of 65 ft.

Distribution.—(In '88.) *Mains*, 6½ miles. *Hydrants*, Chapman, 60. *Valves*, Chapman.

Financial.—(In '88.) Cost, $75,000.

Management.—(In '88.) Prest., S. K. Felton, Omaha.

NOTE.—No report could be obtained for '89.

Water-Works Projected with Fair Prospects of Construction.

AINSWORTH, *Brown Co.* (Pop., est., 1,000.)

Proposed Works.—City to build in '90. Supply, well, pumping to stand-pipe. Est. cost, $8,000. Address W. H. Baldwin, Report, Mar. 7, '90.

ARAPAHOE, *Furnas Co.* (Pop., 470; est., 1,500.) On Republican river.

Proposed Works.—City to build for fire protection. Supply, wells, pumping to tank. Est. cost., $8,000. Bonds not voted and nothing definite done July 29, '89.

ATKINSON, *Holt Co.* (Pop., 417; est., 1,100.) On Elkhorn river. Has flour mill and brewery.

Proposed Works.—City to build summer of '90. Supply, wells (probably), pumping to reservoir. Est. cost, $8,000; to be met by bonds. Mayor, A. L. More. Report, Jan. 16, '90.

COZAD, *Dawson Co.* (Pop., 292; est., 700.)

Proposed Works.—City to build. Supply, canal, pumping to reservoir. Est. cost., $5,000. Address, A. T. Gatewood or G. W. Fox. Report, Jan. 8, '90.

CRAB ORCHARD, *Johnson Co.* (Pop., est., 300.)

Proposed Works.—Under consideration since May, '89, or earlier. Nothing definite.

CRAWFORD, *Dawes Co.* (Pop., not given.)

Proposed Works.—Desired in '90. Address Chas. J. Grabb.

HARRISON, *Sioux Co.* (Pop., est., 300.)

Proposed Works.—Village to build. Supply, well, by pumping. Est. cost $5,000; village voted $2,000 of bonds in or prior to '89, but found amount would be insufficient, so postponed construction till '90. Address A. J. Babcock. Report, Sept, 10, '89.

HAY SPRINGS, *Sheridan Co.* (Pop., est., 700.) Is 25 miles from Omaha.

Proposed Works.—Village to build in '90, principally for fire protection. Supply, artesian well, water 30 feet below surface, pumping to tank on hill about 100 ft. above town. Pipe to be laid in Main St., about 4 blocks, and 5 or 6 hydrants placed. Est. cost, $5,000. Bonds voted. Village Clerk, M. Fipch. Report, Apr. 15, '90.

HOOPER, *Dodge Co.* (Pop., 204; est., 700.)

Proposed Works.—City to build in '90. Contracts were to be let Mar. 10. Supply, by pumping to reservoir. Est. cost, $10,000; $5,400 to be met by bonds. Clerk, T. W. Lyman. Reports, Oct. 12, '89, about Feb. 15, '90.

HUMBOLDT, *Richardson Co.* (Pop., 917; est., 1,500.)

Proposed Works.—City to build. Supply, wells, pumping to reservoir. Est. cost, $17,000. Money not raised. Report by I. E. Shranger; date, Mar. 13, '90.

MINDEN, *Kearney Co.* (Pop., est., 1,700.)

Proposed Works.—City to build. Supply, wells, pumping to stand-pipe. Est. cost, $25,000; to be met by bonds. Report by J. B. Pugh; date, about Dec. 1, '89.

SYRACUSE, *Otoe Co.* (Pop., 510; est., 1,000.) Has flour mills.

Proposed Works.—Under consideration Mar. 19, '90 Principally for fire protection. Pumping necessary. Est. cost, $5,000 to $10,000. Address W. F. Jennings.

Water-Works Projects Reported in '89 and '90, but Now Indefinite.

Bancroft, Cuming Co.; *Dodge*, Dodge Co. *Guthenburg*, Dawson Co. *Indianola*, Red Willow Co. *Lexington*, Dawson Co. *Mason City*, Custer Co. see MANUAL for '88, p. 454. *Ogallala*, Keith Co. *O'Neil*, Holt Co. *Osceola*, Polk Co. *Republican City*, Harlan Co. *Stanton*, Stanton Co. *Tekamah*, Burt Co.

SOUTH DAKOTA.

Water-Works Completed or in Process of Construction.

ABERDEEN, *Brown Co.* (Pop., est., 7,500.) Has manufacturing and trade interests. Incorp. Has sewers and electric lights.

History.—Built in '85 by town under direction of City Engr. Contrs., E. T. Sykes & Co., Minneapolis, Minn.

Water Supply.—Two flowing artesian wells, by gravity. First well is 5½ ins. in diam., 906 ft. deep, with cap. of 3,000,000 galls. Second well is 6 ins. in diam. at top, 4½ at bottom. 1,000 ft. deep; used to run sewage pump and as auxiliary, in case of accident or fire.

Distribution.—*Mains*, 6 and 4-in. c. i., 4¼ miles. *Services*, w. i. *Taps*, 186. *Meters*, none. *Hydrants*, Ludlow, Mathew, 35.

Consumption, unknown. *Pressure:* Ordinary, 110 lbs. Fire, 140 lbs.

Financial.—Cost, $20,000. Debt, $20,000. Int., 6%. Ann. op. exp., $1,300. Ann. rev.: consumers, $406; city, $4,160.

Management.—Com. from Council. City Engr., W. P. Butler.

ANDOVER, *Day Co.* (Pop., est., 350.)

History.—Distribution laid in '88 by village, C., M. & St. P. Ry. Co. already having artesian well.

Water Supply.—Artesian well [probably], by gravity. See History.

Distribution.—*Mains*, 4-in., ¾ miles. *Services*, lead. *Taps*, 16. *Meters*, none. *Hydrants*, Ludlow, 4. *Valves*, Ludlow.

Pressure: Ordinary, 50 lbs. Fire, 100 lbs.

Financial.—Cost, $3,000. Bonded debt, $2,000. Int., 7%. Ann. op. exp., none. Ann. rev.: consumers, $180.

Management.—Supt., Chas. W. Carpenter.

BROOKINGS, *Brookings Co.* (Pop., est., 1,800.) Has milling interests. Has electric lights.

General Description.—Built in '89-90 by city; put in operation about Feb. 1. To be run in connection with electric lights. Supply, deep well, pumping to tank. Contrs.: for power, E. E. Gaylord; tank, Hauxhurst & Hamlin; mains, P. W. Morgan. Cost, $4,000; money raised by "citizens' aid." Report, Jan. 10, '90.

CHAMBERLAIN, *Brule Co.* (Pop., 1,200; est.,1,500.) On Missouri river, at base of, and on bluffs rising 400 ft. above water. Manufactures flour and cigars. Settled in '80; incorp. city in '82. No sewers. Electric lights projected.

History.—Built in '84 by city. Des. Engr., W. C. Stripe. Const. Engr., B. B. Colburne.

Water Supply.—Missouri river, pumping to reservoir.

Pumping Machinery.—Dy. cap., 500,000 galls.; Worthington; 10 and 16-in. steam and 7-in. water cylinder of 10-in. stroke.

Reservoir.—Cap., about 500,000 galls.; area, 2 acres; 112 ft. in diam. at top, 70 ft. at bottom, 12 ft. deep; in excavation and embankment near top of side hill. Embankment, 14 ft. high, 10 ft. wide on top. Inner slope, 1½ to 1, paved with two layers of soft brick on end, laid in cem. Bottom lined with cem. *Discharge-pipes:* two, 5-in. supply and 12-in. waste. Leaks badly on bottom, causing land-slide down hill, some distance below. Built in '83-4. Engrs., see History. Cost, $3,500.

Distribution.—*Mains*, w. i., 2½ miles. *Services*, galv. i. *Taps*, 75. *Meters*, 35. *Hydrants*, Ludlow, 12.

Consumption, 40,000 galls. *Pressure*, 100 lbs.

Financial.—Cost, $25,000. Debt, $21,000. Int., 8%. Sinking fund, $800. Ann. op. exp., $2,000. Ann. rev.: consumers, $2,000.

Management.—Mayor, S. W. Duncan. Supt., C. C. Morrow.

COLUMBIA, *Brown Co.* (Pop., 133; est., 800.) On James river.

General Description.—Owned by village. Supply, flowing artesian well with natural pressure of 180 lbs. Chn. Com. (in '88), Jno. Nelson. No further data can be obtained.

DEADWOOD, *Lawrence Co.* (Pop., 3,777; est., 3,500.) On Whitewood creek in broken, rocky region. Settled in '76; incorp. city in '83. Has sewers and electric lights.

History.—Built in '79 by Black Hills Canal and Water Co., under exclusive 20-years franchise; now owned by Homestake Mining Co. Engr., R. D. Millet.

Water Supply.—Whitewood creek, by gravity to tanks. Drainage area, about 120 sq. m.

Conduit.—Diam., not given; length, about 2 miles; of 1½-in lumber, laid 2 ft. underground, conveying water from point 180 ft. above town to tanks. Rebuilt in '89.

Tanks.—Cap., 150,000 galls.; three, each 20 x 50 ft., x 10 ft. deep. Built on ground, of 16-in. timbers, uprights being 2 ft. apart, framed into sills and caps, and lined with 4-in. plank. So connected with supply main that each can be used independently.

Distribution.—*Mains*, w. i., 5 miles. *Services*, w. i. *Taps*, 190. *Meters*, none. *Hydrants*, Ludlow, 19. *Valves*, Eddy.

Consumption, about 70,000 galls. *Pressure*, 80 lbs.

Financial.—Cost, $70,400. Cap. stock, withheld. No debt. Ann. op. exp., about $5,000. Ann. rev.: withheld, est., $7,000; city, none.

Management.—Supt., T. J. Grier.

DOLAND, *Spink Co.* (Pop., est., 400.)

General Description.—Built in '89 by village; completed Dec. 15. Supply, artesian well, by gravity. Well is 4½ ins. in diam., 937½ ft. deep; dy. flow, about 850,000 galls.; natural pressure, 150 lbs. *Mains*, 5-in. kal. i., 375 ft. *Taps*, 1 hotel supplied. *Hydrants*, Ludlow, 2. Cost, $4,200. Managed by Village Board. Report about Jan. 25, '90.

HURON, *Beadle Co.* (Pop., 164; est., 5,000.) On James river. Has manufactories. Incorp. Has sewers and electric lights.

History.—Built in '84 by town.

Water Supply.—Flowing artesian well, by gravity, and James river, direct pumping. Supply was formerly wholly from latter, which is now used only in emergency. Well is 863 ft. deep, has dy. yield of over 1,500,000 galls., and, when closed, pressure of 170 lbs. Cost, $5,000. City contemplates boring another artesian well.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Blake, *Boilers:* two, 60-H. P., return flue.

Distribution.—*Mains*, kal. i., 2½ miles. *Services*, kal. i. *Taps*, 125. *Meters*, none. *Hydrants*, Ludlow, 17. *Valves*, Ludlow.

Consumption, 200,000 galls. *Pressure:* Ordinary, 70 lbs. Fire, 100 lbs.

Financial.—Cost, $29,000. Bonded debt, $29,000. Int., 7%. Ann. op. exp., $700. Ann. rev.: consumers, $2,500.

Management—Chn., C. H. Cameron. Supt., Alex. McIntosh.

MILBANK, *Grant Co.* (Pop., est., 1,700.)

General Description.—Owned jointly by C., M. & St. P. Ry. Co., and city. No further data.

MILLER, *Hond Co.* (Pop., est., 1,000.) Has manufactories. Incorp. town. No sewers or electric lights.

History.—Built by town; well sunk in '86, but not stated when distribution was put in.

Water Supply.—Six-in. flowing artesian well, by gravity. Dy. yield, est. at 3,900,000 galls. Contrs., Gray Bros., Milwaukee, Wis.

Distribution.—*Mains*, 6-in., 3.8 miles. *Taps*, 50.

Pressure: Natural, 195 lbs.; reduced to 100 lbs.

Financial.—Cost, $16,000. Bonded debt, $16,000. Int., 6%. Ann. op. exp., $600. Ann. rev., consumers, $800.

Management.—Mayor, W. W. Emmons. Secy., G. C. Briggs. Supt., Robt. Corrin. Report, Mar. 7, '90.

MITCHELL, *Davison Co.* (Pop., 320; est., 5,000.) Has manufactories. Incorp. city. Sewers contemplated. Has electric lights.

History.—Built in '87 by town. Contrs., U. S. Wind Engine & Pump Co., Batavia, Ill.

Water Supply.—Two artesian wells, pumping to reservoir and direct. One well has natural flow.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Knowles.

Reservoir.—Cap., about 800,000 galls.; 110 x 13 ft.; 22 ft. above pump. Embankment of earth. Inner slope paved with 2 ft. of rock in cem. Bottom paved with 6 ins. of cem. Built in '86. Engr., J. B. Colburne. Contrs., Goody, Kroutz & Perry. Cost, $6,000.

Distribution.—*Mains*, c. i., 4½ miles. *Services*, w. i., lead. Pipes, specials, valves and hydrants from Rhodes & Ramsey, Chicago, Ill. *Taps*, 100. *Meters*, none. *Hydrants*, 27.

Consumption, not given. *Pressure:* Ordinary, 40 to 60 lbs. Fire, 100 to 150 lbs.

Financial.—Cost, $65,000. Bonded debt, $65,000. Int., 7%. Ann. op. exp., $1,500. Ann. rev.: consumers, $800.

Management.—City Council. Treas., D. W. Ward. Supt., J. Kimball.

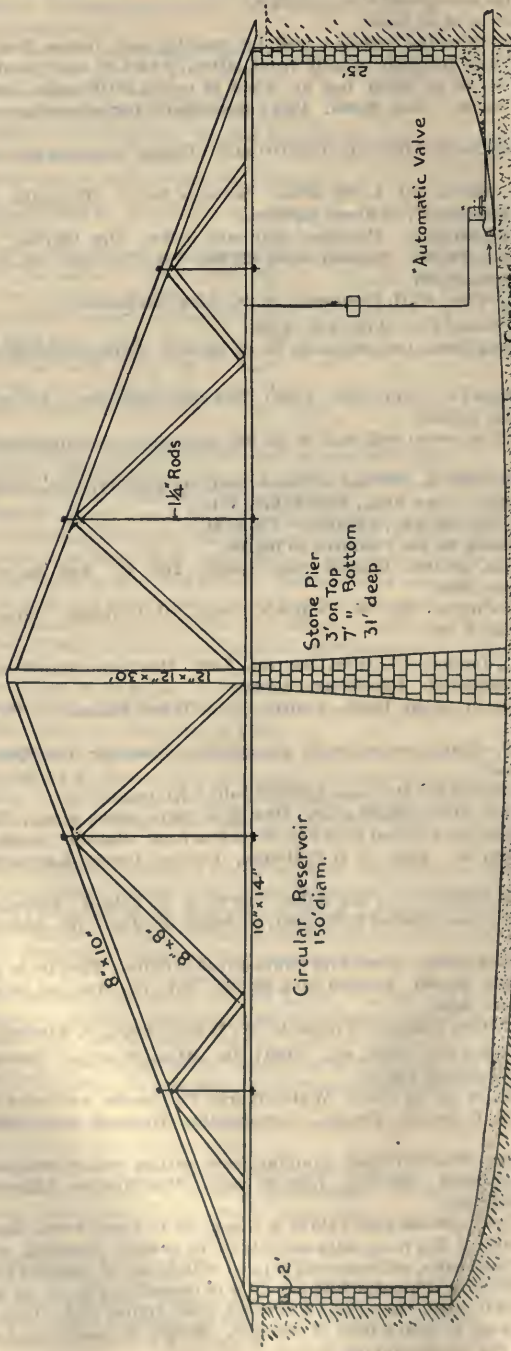
PIERRE, *Hughes Co.* (Pop., est., 5,000.) On Missouri river. Incorp. Partially sewered. Has electric lights.

History.—Built in '85 by Pierre Water-Works Co., under exclusive 25 years franchise. Engr., G. E. Beach. Contrs., Northwestern Water & Gas Supply Co., Minneapolis.

Water Supply.—Missouri river, pumping from settling well to reservoir.

Pumping Machinery.—Dy. cap., 1,250,000 galls.; Worthington high-pressure, comp., dup. *Boilers:* two.

Reservoir.—Cap., 1,000,000 galls.; 150 ft. in diam.; 254 ft. above town. Excavated in hard loam to depth of 27½ ft. at sides and 31½ ft. in center. Masonry wall 2 ft. wide is built up around sides, and reservoir is lined with 18 ins. of concrete formed of Portland cem. and broken stone. Pier in center of masonry, 3 ft. sq. at top, 9 ft. square at bottom, 31 ft. high. Reservoir is covered with timber roof. Inlet pipe is protected from leakage by heavy body of concrete. Supply of water is controlled by automatic valve. See accompanying section.



Cross-Section of Reservoir, Pierre, So. Dak.

Distribution.—*Mains*, kal. i., 7¼ miles. *Services*, kal. i., lead. *Taps*, 60. *Meters*, Worthington, 8. *Hydrants*, Ludlow, 60. *Valves*, Ludlow.

Consumption, 39,000 galls. *Pressure:* Ordinary, 110 lbs. Fire, 200 lbs.

Financial.—Cost, $159,500. Cap. stock, $125,000, paid up. Debt, $75,000. Int., 6%. Ann. op. exp., $3,000. Ann. rev.: consumers, $2,500; city, $6,000. Hydrant rental, $100.

Management.—Prest., G. E. Beach, Minneapolis, Minn. Secy. and Treas., M L. Knowlton. Supt. and Engr., J. W. Troy.

PLANKINGTON, *Aurora Co.* (Pop., est., 800.)

General Description.—Built in '87-8 by village. Contr., J. F. Barton. Water supply, flowing artesian well, by gravity. *Mains*, iron, 2 miles. *Taps*, 116. *Hydrants*, Chapman, 14. *Pressure*, 140 lbs. Cost, $8,000. Bonded debt, $10,600. Int., 7%. Mayor, Jno. Rogers. Supt., W. G. Andrews.

NOTE.—No report for '89 could be obtained

RAPID CITY, *Pennington Co.* (Pop., 292; est., 5,000.) On Rapid river in mining region. Has water-power. No sewers. Has electric lights.

History.—Built in '85-6 by city. Des. Engr., Myron Wiltsy. Const., Engr., G. E. Beach. Contrs., Northwestern Water & Gas Supply Co., Minneapolis, Minn.

Water Supply.—Spring, 214 ft. above town, by gravity to reservoir.

Reservoir.—Cap., 400,000 galls.; 175 ft. above town.

Distribution.—*Mains*, kal. i , 5 miles. *Services*, w. i. *Taps* (in '87), 175. *Meters*, none. *Hydrants*, Ludlow, 23. *Valves*, Ludlow.

Consumption, 600,000 galls. *Pressure*, 70 lbs.

Financial.—Cost, $50,000. Debt, $51,000. Int., 7%. Ann. op. exp., $1,500. Ann. rev.: consumers, $5,000.

Management.—Supt. (in '88), Jas. Long, Jr. Report by G. E. Beach.

REDFIELD, *Spink Co.* (Pop., est., 1,400.) On James and Turtle rivers.

History.—Built in '86 by town. Contrs., Gray Bros., Milwaukee, Wis.

Water Supply.—Flowing artesian well, by gravity.

Distribution.—*Mains*, 6-in. w. i., 3 miles. *Services*, not given. *Taps*, 300. *Meters*, none. *Hydrants*, White, 4.

Consumption, not given. *Pressure*, 160 lbs.

Financial.—Cost, $5,000. Debt, not given. Int., 7%. Ann. op. exp., $251. Ann. rev.: consumers, withheld, est., $1,200.

Management.—Supt., W. D. Beebe.

REE HEIGHTS, *Hand Co.* (Pop., est., 100.)

General Description.—Chicago & Northwestern Ry. Co. has water tank from which pipes extend. Address F. D. Ensign.

SALEM, *McCook Co.* (Pop., est., 800.) Incorp. city. No sewers or electric light.

History.—Built in '87-8 by village. Contr., S. K. Felton.

Water Supply.—Well, 225 ft. deep, pumping to tank.

Pumping Machinery.—Dy. cap., 50,000 galls.; windmill pump.

Tank.—Cap., 60,000 galls.

Distribution.—*Mains*, kind not given, ½ mile. *Services*, not given. *Taps*, 13. *Hydrants*, kind not given, 4.

Consumption, 3,200 galls. *Pressure*, 40 lbs.

Financial.—Cost, $6,150. Debt, $4,725. Int., 7%. Ann. op. exp., $75. Ann. rev.: consumers, $42.

Management.—Council. Secy., W. E. Lane. Supt., M. A. Blackburn.

SCOTLAND, *Bon Homme Co.* (Pop., 150; est., 1,500.) Incorp. city. No sewers or electric lights.

History.—Built in '89 by city; put in operation Jan. 1, '90. Des. Engr., Chas F. Loweth, St. Paul, Minn. Contrs., Fairbanks, Morse & Co., Chicago, Ill.

Water Supply.—Well, pumping direct and to tank.

Pumping Machinery.—Dy. cap., 750,000 galls.; Smith & Valle.

Distribution.—*Mains*, 6 and 4-in. c. i., iron, 2 miles. *Taps*, 6. *Hydrants*, 7.

Financial.—Cost, $15,000. Debt, $14,000. Int., 6%.

Management.—Secy., J. M. Dain. Supt., W. B. Robinson. Report by J. V. Teibel; date, Mar. 3, '90.

SIOUX FALLS, *Minnehaha Co.* (Pop., 2,164; est., 11,000.) On Sioux river. Has water-power and stone quarries. Has electric lights.

History.—Built in '84 by Sioux Falls Water Co., under 20-years exclusive franchise, and controlled by American Water-Works & Guarantee Co., Ltd., Pittsburgh, Pa.

Water Supply.—Wells and Sioux river, filtered, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; Worthington.

Filter.—Dy. cap., not given; National.

Stand-Pipe.—Cap., 440,000 galls.; 30 x 84 ft.

Distribution.—(In '87.) *Mains*, c. i., 9½ miles. *Services*, galv. i. *Taps*, 380. *Meters*, not given. *Hydrants*, Ludlow, 50. *Valves*, Ludlow.

Consumption, 500,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 90 lbs.

Financial.—(In '87.) Cost, $105,000. Cap. stock, $100,000. Bonded debt, $60,000. Int., 6%. Ann. op. exp., withheld, est., $5,000. Ann. rev.: total, $10,485. Hydrant rental, $73.

Management.—(In '88.) Secy., W. S. Kuhn, Pittsburgh, Pa. Supt., C. H. Marten.

NOTE.—No report for '89 could be obtained.

SPEARFISH, *Lawrence Co.* (Pop., 170; est., 1,200.) Has water-power. Incorp. city. No sewers or electric lights.

History.—Built in '87 by town, under direction of L. Harper.

Water Supply.—Springs, by gravity to tank. Springs are 4,000 ft. from tanks; av. dy. flow, 209,455 galls.

Tank.—Cap., not given; 90 ft. above city.

Distribution.—*Mains*, kind not given, 3 miles. *Services*, not given. *Taps*, 48. *Meters*, none. *Hydrants*, kind not given, 12.

Consumption, 85,000 galls. *Pressure*, 90 lbs.

Financial.—Cost, $17,500. Debt, $17,500. Int., 7%. Ann. op. exp., $250. Ann. rev.: consumers, $1,180; city, $800.

Management.—Supt., M. Berg. Report by J. T. L. Henry.

TYNDALL, *Bon Homme Co.* (Pop., est., 1,000.) Incorp. city. No sewers or electric lights.

General Description.—Built latter part of '89 by village. Contr. for material, N. O. Nelson Mfg. Co., St. Louis, Mo.; for labor, Eugene Tangney, Sanborn, Ia. Supply, artesian well, by gravity; 4½-in. well, 735 ft. deep. *Mains*, 6 and 4-in. c. i., about 2 miles. *Hydrants*, White, 14. Cost, $7,000. Bonded debt, $7,000. City Auditor, Henry B. Phœnix. Latest report, Feb. 11, '90.

WATERTOWN, *Codington Co.* (Pop., 746; est., 5,000. Incorp. city. No sewers. Has electric lights.

History.—Built in '88 by Watertown Water-Works Co., under 20-years franchise. Des. Engr., Howland & Ellis, Boston, Mass. Const. Engrs., H. F. Dunham, Cleveland, O., and D. C. Henry, Boston, Mass.

Water Supply.—Lake Kampeska, 3 miles from city, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two Deane, comp., dup., direct. acting; one a high-pressure. *Boilers:* from Wm. Allen & Son, Boston, Mass.

Stand-Pipe.—Cap., 211,800 galls.; 20 x 90 ft.; from Tippett & Wood, Phillipsburgh, N. J.

Distribution.—*Mains*, c. i., 8.8 miles. *Services*, galv. i., lead. *Taps*, 140. *Meters*, Frost, 15. *Hydrants*, Chapman, 80 *Valves*, Chapman.

Consumption, 220,000 galls. *Pressure:* Ordinary, 50 lbs. Fire, 100 lbs.

Financial.—Cost, $276,000. Cap. stock, $15',000. Bonded debt, $126,000. Int., 6%. Ann. op. exp., $3,600. Ann. rev.: consumers, $7,000; city, $5000. Hydrant rental, $5,000 a year for those on first 5.3 miles, $48 each for additional, one for each 440 ft. of extensions.

Management.—Prest. and Secy., W. E. Scarritt. Treas., E. W. Thomas. Supt., M. Smith.

WOONSOCKET, *Sanborn Co.* (Pop., est., 1,000.)

General Description.—Built in '89-90. Supply, flowing artesian well, by gravity; 6-in. well, 725 ft. deep; est. hourly yield, 3,000 to 6,000 galls. Contrs. for well, Gray Bros., Milwaukee, Wis. *Mains*, 6-in., ⅛ mile; 1 mile additional proposed. *Pressure*, when well is closed, 150 lbs.; with 2-in. opening, 120 lbs. Cost of well, $1,000. Mayor, C. E. Hinds. Well Comr., Wm. H. Burdick. Report, Mar. 21, '90.

YANKTON, *Yankton Co.* (Pop., 3,431; est., 4,000.) On Missouri river, on smooth plateau, with high and regular slopes on north and west. Has woollen mill and breweries. Settled in '56; incorp in '69, and reincorp. city in '73. Has sewers and electric lights.

History.—Built in '84 by city. Des. Engr., Ed. Palmer. Const. Engrs. and Contrs., Fairbanks, Morse & Co., Chicago, Ill.

Water Supply.—Flowing artesian well, by gravity to tanks. Well has dy. yield of about 2,000,000 galls.

Tanks.—Cap., 62,000 galls.; two, of wood.

Distribution.—*Mains*, Wyckoff wood, 3½ miles. *Services*, iron. *Taps*, 140. *Meters*, none. *Hydrants*, Holly, 21.

Consumption, 1,000,000 galls. *Pressure*, 35 lbs.

Financial.—Cost $36,000. Bonded debt, $28,000. Int., 6%. Ann. op. exp., $500. Ann. rev.: consumers, $1,750.

Management.—Chn. Com., J. Branch. Supt., L. Karr.

Water-Works Projected with Fair Prospects of Construction.

FAULKTON, *Faulk Co.* (Pop., est., 600.)

Proposed Works.—Artesian well sunk in '89-90, by village; depth, 1,210 ft.; natural pressure, 100 lbs. Contrs., Gray Bros., Milwaukee, Wis. Original intention was to put in distribution if flow could be secured. Est. cost, $10,000.

FORT SULLY, *Sully Co.* (Pop., 4 companies of U. S. Infantry.)

Proposed Works.—U. S. Government to build in '90. Bids were asked for Feb. 15. Supply, Missouri river, pumping to tank. Est. cost, $10,000. Report by D. F. Anglum, Post Q.-M., U. S. A.

FRANKFORT, *Spink Co.* (Pop., est., 500.)

Proposed Works.—Village has flowing artesian well sunk in or prior to '89. June 22, '89, putting in of distribution was under consideration. Est. cost, $5,000. No money raised.

GETTYSBURGH, *Potter Co.* (Pop., est., 600.)

Proposed Works.—Jan. 9, '90, village had well down 1,300 ft., then in shale, with no water. Cost to that date, $6,000. It was thought well would be sunk deeper in '90, and distribution was under consideration. Address Jas. Bryson or A. D. Packer.

GROTON, *Brown Co.* (Pop., not given.)

Proposed Works.—Bids were asked to be opened July 10, '89, for artesian well 400 to 600 ft. deep, with 6-in. casing; well to be furnished ready to attach to water mains. City Auditor, W. B. Miller.

HIGHMORE, *Hyde Co.* (Pop., est., 500.)

Proposed Works.—Village has flowing artesian well, and may put in distribution. Oct. 13, '89, matter was quite indefinite.

IROQUOIS, *Kingsbury Co.* (Pop., est., 300.)

Proposed Works.—Village has contracted for 6-in. artesian well, for power, from which it hopes to obtain a heavy pressure. Chn. Trustees, J. J. Sweet.

MADISON, *Lake Co.* (Pop., 96; est., 2,500.)

Proposed Works.—Artesian well to be sunk in '90. Address R. C. McCallister.

MELLETTE, *Spink Co.* (Pop., est., 300.)

Proposed Works.—Village has artesian wells and will lay mains in '90. Address Chn. Town Board.

PARKER, *Turner Co.* (Pop., 50; est., 800.) Has elevator and mills.

Proposed Works.—Village to build in '90. Supply, artesian well, pumping to tank. Chn., R. E. Buchanan. Clerk, F. L. Crisby.

VILAS, *Miner Co.* (Pop., est., 700.)

Proposed Works.—Village drilling artesian well in Mar.; '90; flow expected. Distribution for general supply proposed. Money to be raised by tax.

WHITEWOOD, *Lawrence Co.* (Pop., not given.) In valley of Whitewood creek.

Proposed Works.—Organizing about Mar. 20, '90. Unofficially reported that works would be in operation June 1.

Water-Works Projects Reported in '89 and '90, but Now Indefinite.

Canton. Lincoln Co.; see MANUAL for '88, p. 459. *Gordon,* Jerauld Co. *Raymond,* Clark Co.

NORTH DAKOTA.

Water-Works Completed or in Process of Construction.

BISMARCK, *Burleigh Co.* (Pop., 1,758; est., 3,500.) On Missouri river. Has electric lights.

History.—Built in '87 by Bismarck Water Co.; put in operation Jan. 1, '89. Engr., J. Albert Monroe. Consult. Engrs., Morison & Corthell, Chicago, Ill.

Water Supply.—Missouri river, pumping to reservoirs.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; Deane.

Reservoirs.—Cap., 2,000,000 galls.; two 1,000,000-gall. stone reservoirs.

Distribution.—(In '88.) *Mains,* c. i., 6 miles. Pipe and specials from R. D. Wood & Co., Philadelphia, Pa.; trenching and pipe-laying done by Mooney & Dohaher. *Taps,* withheld, est., 150. *Meters,* 24. *Hydrants,* not given.

Pressure, 65 lbs.

Financial.—(In '88.) Cost, $110,000. Cap. stock, $100,000. Bonded debt, $100,000. Int., 6%. A 20-years hydrant contract.

Management.—(In '88.) Prest., E. H. Bly. Secy., Alex. Hughes.

NOTE.—No report could be obtained for '89.

ELLENDALE, *Dickey Co.* (Pop., est., 1,000.)

History.—Built in '86 by town. Engrs., Gray Bros., Milwaukee, Wis.

Water Supply.—A 6-in. artesian well; mode not given, but probably by gravity.

Distribution.—(In '87.) *Mains,* 4-in. iron, ¾ miles. *Services,* galv. i. *Taps,* 16. *Meters,* none. *Hydrants,* kind not given, 5.

Consumption, not given. *Pressure:* Ordinary, 100 lbs. Fire, 140 lbs.

Financial.—(In '87.) Cost, $7,000. Bonded debt, $5,000. Int., 7%. Ann. op. exp., $150. Ann. rev.: consumers, $130; city, $130.

Management.—(In '87.) Supt., Jas. Lacey.

NOTE.—No report could be obtained for '89.

FARGO, *Cass Co.* (Pop., 2,693; est., 7,000.) On Red River of the North, 32 ft. above low water, 4 ft. above high water in '82, and 917 ft. above sea. Settled in '73; incorp. city in '75. Has electric lights.

History.—Built in '89 by Fargo Water & Steam Co., under 30-years franchise. Contrs., Holly Mfg. Co., Lockport, N. Y.

Water Supply.—Red River of the North, direct pumping from settling basins.

Settling Basins.—No data.

Pumping Machinery.—Dy. cap., 2,250,000 galls.; 1,500,000 Holly quadruplex and 750,000 Gaskill duplex.

Distribution.—(In '87.) *Mains,* c. i., 10½ miles. *Services,* w. i., lead. Pipe and specials for original works from Shickle, Harrison & Howard Iron Co.; laid by T. E. Cowell, Muscatine, Ia. *Taps,* 413. *Meters,* 160. *Hydrants,* Holly, 56. *Valves,* Chapman. *Pressure-recording gauge,* Edson.

Financial.—(In '87.) Cost, $80,000. Cap. stock, $29,800, paid in, with $75,000 authorized. Bonded debt, $18,000. Int., 7%. Ann. op. exp., $18,000. [Probably includes interest and construction.] Ann. rev.: consumers, $12,520; city, $5,480. Hydrant rental, $100 for 50, $80 for additional.

Management.—(In '88.) Prest., Chas. Sweat. Secy., W. B. Douglas. Report by S. W. Curtis, Cashier.

NOTE.—No report for '89 could be obtained.

FORT BUFORD, *Buford Co.* (Pop., 500.) A U. S. military post. Sewers under construction in '89.

History.—Built in '86 by U. S. Government.

Water Supply.—Missouri river, pumping to tank and direct.

Pumping Machinery.—Dy. cap., 100,000 galls.; Knowles. *Boiler:* 40-H. P.; in mill.

Tank.—Cap., 36,000 galls.; 16 x 2

Distribution.—*Mains*, kal. i., 1.9 miles. *Services*, kal. i. *Taps*, 50. *Meters*, none. *Hydrants*, Ludlow, Wilkes-Barre, 10.

Consumption, 20,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 120 lbs.

Financial.—Cost, $8,000. No debt or rev. Ann. op. exp., $2,000.

Management.—Supt., S. J. Lillie.

FORT PEMBINA, (*P. O. Pembina*) *Pembina Co.* (Pop., 160.) On Red River of the North, near Pembina. No sewers or electric lights.

History.—Built in '85-6 by U. S. Government. Des. Engr., W. H. Wood, St. Paul, Minn. Const. Engr., Chas. Dougherty, Fort Pembina.

Water Supply.—Red River of the North, pumping to tank and direct. Reservoir or pump-well projected in '89 from which water from river will flow by gravity. Est. cost., $1,200.

Pumping Machinery.—Dy. cap., 100,000 galls.; Knowles dup. *Boiler:* 15-H. P. upright, tubular. Both bought of Robt. Corey & Co., St. Paul, Minn.

Tank.—Cap., 35,000 galls.: 20 x 16 ft.

Distribution.—*Mains*, kal. i., 7 miles. *Services*, w. i. *Taps*, 24. *Meters*, none. *Hydrants*, Wilkes-Barre, 4.

Consumption, 4,500 galls. *Pressure:* Ordinary, 29 lbs. Fire, 70 lbs.

Financial.—Cost, $4,294. No debt or rev. Ann. op. exp., $1,298.

Management.—In charge of Lieut. L. S. Roudiez, U. S. A., Pembina, Dak.

FORT TOTTEN, *Ramsey Co.* (Pop., 150.)

History.—Built in '85 by U. S. Government.

Water Supply.—Spring, pumping to tank.

Pumping Machinery.—Dy. cap., 48,000 galls.: Knowles. *Boiler:* 10-H. P., upright.

Tank.—Cap., 35,000 galls.; 20 x 16 ft.; at elevation of 80 ft.

Distribution.—*Mains*, iron, 1 mile. *Services*, w. i. *Taps*, 50. *Meters*, none. *Hydrants*, Ludlow, 6.

Financial.—Cost, $6,000. No debt or rev. Ann. op. exp., $1,500.

Consumption, 6,000 galls. *Pressure*, 40 lbs.

Management.—Post Quartermaster, Lieut. Theo. Mosher, U. S. A.

GRAFTON, *Walsh Co.* (Pop., est., 2,500.) Incorp. No sewers. Has electric lights.

History.—Built in '86 by town. No Engr. Contrs., C. H. Powett, Fargo, and Thos. Hennessey, Grand Forks.

Water Supply.—A 912-ft. artesian well, by direct pumping.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Gordon & Maxwell dup.

Distribution.—*Mains*, 6-in. iron, 1¼ miles. *Services*, iron. *Taps*, 114. *Meters*, none. *Hydrants*, Holly, 12.

Consumption, 100,000 galls. *Pressure:* Ordinary, 15 lbs. Fire, 120 lbs.

Financial.—Cost, $29,460. Debt, $10,000. Int., 6%. Sinking fund, $1,500. Ann. op. exp., $2,850. Ann. rev.: consumers, $1,100.

Management.—Report by D. W. Yorkey.

GRAND FORKS, *Grand Forks Co.* (Pop., 1,705; est., 7,000.) On Red River of the North. Incorp. Has sewers and electric lights.

History.—Built in '82 by city. Const. Engr., W. S. Russell.

Water Supply.—Red Lake river, by direct pumping. Water is taken at point just above junction of river with Red River of the North.

Pumping Machinery.—Dy. cap., 5,000,000 galls.; 500,000 Knowles; 1,500,000 Blake, dup.; 3,000,000 "special design," having three vertical outside packed plungers connected to crank-shaft, automatic engines.

Distribution.—*Mains*, c. i., kal. i., 7 miles. *Services*, w. i. *Taps*, 300. *Meters*, 25. *Hydrants*, Ludlow, 42. *Pressure-recording gauge*, Edson.

Consumption, 700,000 galls. *Pressure:* Ordinary, 80 lbs. Fire, 120 lbs.

Financial.—Cost, $100,000. Debt, $50,000. Int., 7%. Ann. op. exp., $4,500; ann. int., $3,500. Ann. rev.: consumers, $7,000.

Management.—Mayor, Alex. Griggs. City Auditor, Alex. C. Mather. Supt., W. S. Russell.

JAMESTOWN, *Stutsman Co.* (Pop., 393; est., 3,000.) Incorp. No sewers. Has electric lights.

History.—Built in '87-8 by town.

Water Supply.—Flowing artesian well, 1,500 ft. deep, by gravity. Contrs. for well, Gray Bros., Milwaukee, Wis.

Distribution.—*Mains*, ¾ miles. *Taps*, 6. *Meters*, none. *Hydrants*, Holly, 9. *Consumption*, unknown. *Pressure*, 95 lbs.

Financial.—Cost, $12,000. Debt, $10,000. Int., 7%. No op. exp. Ann. rev.: consumers, $200.

Management.—Secy., A. Blewett. Supt., Jno. F. Vennum.

MANDAN, *Morton Co.* (Pop., 239; est., 3,000.) On Missouri river at mouth of Heart river. Incorp. city.

History.—Built in '84 by town, for fire protection,

Pumping Machinery.—Dy. cap., not given; Worthington.

Distribution.—*Mains*, w. i., 1½ miles. *Hydrants*, kind not given, 10. *Valves*, Ludlow.

Pressure: Fire, 140 lbs.

Financial.—Cost, $6,000. No debt. Ann. op. exp., about $25. No. rev.

Management.—Supt., E. C. Rice. Report by Jno. Fogarty.

OAKES, *Dickey Co.* (Pop., est., 800.) Has elevators, foundry and machine shops.

History.—Built in '89-90 by village. Des. Engr., W. P. Butler, Aberdeen.

Water Supply.—Flowing well, by gravity.

Distribution.—*Mains*, 4-in. w. i., 2 miles.

Pressure, 125 lbs.

Management.—Village Council. Address J. E. Spurling. Latest report, about Feb. 10, '90.

WAHPETON, *Richland Co.* (Pop., 400; est., 2,500.) At junction of Red River of the North and Bois des Sioux river. Engaged in manufacturing and trade. Incorp city. Has sewers and electric lights.

History.—Built in '85 by Wahpeton Water Co., under 30-years franchise. Engr., Col. E. R. Davenport, Charleston, W. Va. May 23, '89, property was in hands of trustee for bondholders.

Water Supply.—Otter Tail river, direct pumping.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Worthington. *Boilers:* steel.

Distribution.—*Mains*, kal. i., 6 miles. *Services*, kal. i. *Taps*, 300. *Meters*, 10. *Hydrants*, Ludlow, 30. *Valves*, Ludlow.

Consumption, 85,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 150 lbs.

Financial.—(In '87.) Cost, $76,500. Cap. stock, $50,000. Bonded debt, $50,000. Int., 6%. Ann. op. exp., $6,000. Ann. rev.: consumers, $5,600; city, $2,000. Hydrant rental, $80.

Management.—Supt., E. H. Bishop.

Water-Works Projected with Fair Prospects of Construction.

DEVILS LAKE, *Ramsey Co.* (Pop., not given.)

Proposed Works.—Village has artesian well down 1,520 ft., at which point quicksand was encountered preventing further sinking. Well has dy. flow of about 35,000 galls., but water contains sand. Bad crops in '89 prevented intended attempts to complete well. It is thought that ample flow with good pressure can be obtained if well can be put through quicksand, in which case distribution may be put in. City Auditor, C. M. Fisher.

WYOMING.

Water-Works Completed or in Process of Construction.

CHEYENNE, *Laramie Co.* (Pop., 3,456; est., 10,000.) On Crow creek, 5,900 ft. above sea, on plain sloping 1 ft. in 120. In mining region Settled in '67. Incorp. city. Has sewers and electric lights.

History.—First supplied in '80, by U. P. Ry. putting in Knowles pump, tank and 3,000 ft. of mains. In '82 works were built by town. Engr., W. G. Provines.

Water Supply.—Infiltration wells in bed-rock of Crow creek, by gravity, with direct pumping in case of fire. Previous to '89, supply was from storage reservoirs; they are now used only to supply large manufactories and for irrigation.

Infiltration Wells.—Similar to those at Denver, Colo. No further data.

Dam and Reservoirs.—Cap., 214,000,000 galls. *Crow creek Dam:* Built across creek at head of former supply, 6 miles from city. No further data. *Reservoirs:* 4 natural basins, largest, Lake Mahpealutah having area of 36 acres.

Conduits and Supply Mains.—*Old Conduits:* Nearly 5 miles of 15 and 20-in. vitrified stoneware pipe lead from the dam to reservoirs, fall generally being 1 ft. in 1,250 and about 3 miles are laid between reservoirs.

Old Supply Main: a 12-in. c. i. pipe leads from larger reservoir to city. Dy. cap., 2,514,000 galls.

New Supply Main: 30-in.; from infiltration wells to city, 7 miles long; increases natural pressure 30 lbs. above that given by former service.

Pumping Machinery.—Dy. cap., 8,000,000 galls.; two Knowles.

Distribution.—*Mains*, c. i., 14 miles. *Services*, lead. Pipe and specials from Dennis Long & Co., Louisville, Ky., and Shickle, Harrison & Howard Iron Co., St. Louis, Mo. *Taps*, 750. *Meters*, kind not given, 2. *Hydrants*, Chapman, 90. *Valves*, Chapman.

Consumption, 1,500,000 galls., including 500,000 galls. to U. P. Ry. shops. *Pressure:* Ordinary, 48 lbs. Fire, 150 lbs.

Financial.—Cost, $275,000. Debt (in '87), $130,000. Int., 7%. Ann. op. exp., $7,000. Ann. rev.: consumers, $14,000; city, $7,000.

Management.—Chn. Com., Jno. Roberts. Supt and Engr., Donnell Miller.

DANA and HANNA, *Carbon Co.* (Pop., est., 300 each.) Mining towns about 5 miles apart, former being on Union Pacific Ry.

General Description.—Co. putting in "Rattlesnake Pipe Line" in '90. Engrs., D. G. and T. J. Wyche, Dana. Supply, springs in Elk mountain district, by gravity to and from tank. Springs are about 15 miles from proposed Ry. tank; latter about 3 miles from Dana. Dam will be built at source, from which 12-in. pipe line (probably) will lead to tank, and 8-in. line continue to Hanna, with 8-in. branch to Dana. Est. cost, $175,000 to $200,000. Address T. C. or D. G. Wyche, Dana, or E. C. Kinney, Anaconda, Mont. Report by W. M. Hodgkins, Dana; date, Apr. 12, '90.

DOUGLAS, *Albany Co.* (Pop., est., 900.)

General Description.—Built in '89-90 by town. Supply, Platte river, pumping to reservoir. Cost, $13,500. Bonded debt, $7,000. Town Clerk, M. C. Barrow. Report, Aug. 7, '89

LARAMIE CITY, *Albany Co.* (Pop., 2,696; est., 5,000.) On Laramie river. In mining region. Has manufactories. Incorp. Has sewers and electric lights.

History.—Supplied since '70; works now owned by U. P. Ry. and used for their own supply, and for fire protection in city.

Water Supply.—Springs, 2½ miles east of city, by gravity from reservoir or pond, with area of 5 acres.

Distribution.—*Mains*, w. i. and cem., 5 miles. *Services*, w. i. *Hydrants*, Holly, Beaumont, 24.

Pressure, 40 lbs.

Financial.—Cost, $18,000. No debt. Ann. op. exp., $1,000. No rev., water being free.

Management.—U. P. Ry. Chf. of City Fire Dept., Otto Gramm.

NEW CASTLE, *Cook Co.* (Pop., est., 1,000.)

General Deacription.—Construction begun Feb. 1, '90, by New Castle & Cambria Water Supply Co.; was to be completed May 1, '90. Engr., F. E. Tucker. Labor done by Co. Supply, Sweetwater creek, 12 miles distant, by gravity through flume. Est. cost, $50,000. Officers: W. H. Kilpatrick, R. A. Weston, W. E. Monck. Report, Feb. 14, '90.

RAWLINS, *Carbon Co.* (Pop., 1,451; est., 2,000.) In mining and stock-raising section. Has U. P. Ry. repair shops. Incorp. city. Has sewers. Electric lights projected in '89.

CITY WORKS.

History.—Built in '85. Engr., C. A. Miller, City Engr.

Water Supply.—Artesian well, pumping to tank. Well has 8-in. casing, is 525 ft. deep.

Pumping Machinery.—Dy. cap., 150,000 galls.; Deane vertical steam. Windmill pump was formerly used, having dy. cap. of 25,000 galls.; did not give satisfaction, and was blown down by gale in '86. An old engine and pump with dy. cap. of 2 5,000 galls. was then used; discontinued Apr., '89.

Tank.—Cap., 51,000 galls.; 25 x 16 ft.; built by Eclipse Windmill Co.

Distribution.—*Mains*, 1¾ miles; ½ mile 4-in. w. i. owned by city, remainder by individuals. *Services*, w. i. Pipe and specials from Junguist & Hocker; trenching and pipe-laying done by W. W. Morrow, Pocatello, Ida. *Taps*, 85. *Meters*, none. *Hydrants*, 3.

Consumption, 36,000 galls. *Pressure*, about 100 lbs.

Financial.—Cost, $9,710. No debt. Ann. op. exp., $1,900. Ann. rev.: consumers, $2,200.

Management.—City Engr., C. A. Miller.

UNION PACIFIC RY. CO.'S WORKS.

General Description.—Supply, pumping to 51,000-gall. tank. *Mains*, 4-in. c. i., about ¾ miles; formerly about 3 miles. *Taps*, about 50. *Hydrants*, 3.

ROCK SPRINGS and GREEN RIVER, *Sweetwater Co.* (Pop.: Rock Springs, 765; est., 2,500. Green River, 327; est., 500.) Rock Springs is coal mining camp, 16 miles from Green river, up Bitter creek. Village of Green River is on Green river, and is division station of U. P. Ry., its only industries being those connected with railway.

History.—In '75, U. P. Ry. put in pumps and built tank at Green River to supply their shops and dwellings.

In '86-8, Co. built new pumping works at Green River, and laid pipe to Rock Springs. Latter place is an alkaline region, where water cannot be used for domestic or boiler purposes. For several years water train supplied Rock Springs, taking its supply at Green River. For work lately done V. G. Bogue, R. E. Briggs and E. C. Kinney were Des. Engrs., and latter, Superintendent of Construction. Contrs., A. L. Strang Co., Omaha. Connection was made at Green River between old and new pumping stations by 4-in. pipe with pressure-reducing valve, but ordinarily two systems are operated separately.

GREEN RIVER PLANT.

Water Supply.—Green river, pumping through mains to tank.

Pumping Machinery.—Dy. cap., 150,000 galls.; two No. 9 Knowles.

Tank.—Cap., 26,500 galls.; 15 x 20 ft.

Distribution.—(In '87.) *Mains*, 4-in. c. i., 2 miles. *Taps*, 30. *Meters*, none. *Hydrants*, 10.

Consumption, not given; mostly at round house.

Financial.—Not given.

Management.—Foreman round house, E. A. Linsley.

ROCK SPRINGS PLANT.

Water Supply.—Green river, pumping through 16 miles of pipe directly to mains, surplus going through a Y to reservoir.

Pumping Machinery.—Dy. cap., 500,000 galls.; two Knowles, with 7-in. plungers of 18-in. stroke. *Boilers:* two, 100-H. P., from J. Mohr & Co., Chicago, Ill.

Conduit.—Of 8-in. c. i., 16 miles long, rising about 340 ft. First 100 ft. are of 67-lb. pipe, then comes 3 miles of 50-lb., 1 of 67, 8 of 50, and remainder of 43-lb. pipe. Intermediate pumping station was originally intended, so light pipe was used at lower end. It has been proposed to relay the 3 miles of 50-lb. pipe with 67-lb. One mile from Rock Springs a Y is inserted, and branch run ¾ miles up into hills to reservoir. Just below the Y a check valve is inserted; both line to town and to reservoir being left open. If more water comes through main than is used at town surplus goes to reservoir; if less, reservoir supplies deficiency.

Dam.—Of earth, built across ravine to form reservoir.

Reservoir.—Cap., 3,000,000 galls.

Distribution.—(In '87.) *Mains*, c. i., including conduit, 22 miles; some of distribution pipe is 4-in. but most of it is 8-in. *Services*, lead. *Taps*, 150. *Meters*, 150. *Hydrants*, Chapman, 47. *Valves*, Ludlow.

Consumption, 300,000 galls. *Pressure*, 66 lbs.

Financial.—Cost, about $200,000. Ann. op. exp., $20,000. Rev. from consumers is small, and as most of houses are owned by Co., and villages unincorporated, there is no hydrant rental. Charges to mines and locomotives will be arbitrary, as they are made simply to balance Co.'s accounts with its various departments.

Management.—Supt., E. C. Kinney, Green River.

NOTE.—No report for '89 could be obtained.

SUNDANCE, *Crook Co.* (Pop., est., 600.)

History.—Built in '88 by Sundance Water Supply Co., under 20-years franchise. Engr. and Contr., L. Harper, Omaha, Neb.

Water Supply.—Springs, by gravity, to and from reservoir.

Reservoir.—Cap., est., 60,000 galls.; 14x80 ft., x10 ft. deep.

Distribution.—*Mains*, 8 to 4-in., 1¼ miles. *Taps*, 40. *Meters*, none. *Hydrants*, Ludlow, 10. *Valves*, Ludlow.

Consumption, 10,000 galls. *Pressure*, 70 lbs.

Financial.—Cost, $13,000. Cap. stock, authorized, $40,000. Debt, $8,000. Int., 8%. Ann. op. exp., $750. Ann. rev.: consumers, $2,500; city, $750. Hydrant rental, $75 for first 10, $65 for second 10.

Management.—Prest., W. S. Metz. Secy. and Treas., T. M. Pettigrew.

Water-Works Projected with Fair Prospects of Construction.

EVANSTON, *Unita Co.* (Pop., 1,277; est., 1,800.) Has coal mining and lumber industries.

Proposed Works.—Village to build. Supply from reservoir. Report from E. L. Halloe, Jr.; date, June 22, '89.

FORT D. A. RUSSELL, *Laramie Co.* (Pop., in '80, about 500.) Military post, about 3 miles from Cheyenne.

Proposed Works.—June, '88, C. F. Humphrey, Capt. and Asst. Q.-M., U. S. A., stated that increase in supply was intended.

MONTANA.

Water-Works Completed or in Process of Construction.

ANACONDA, *Deer Lodge Co.* (Pop., est., 400.)

General Description.—Built in '88. Supt. of Const., Jno. R. Toole. There is a reservoir, and 6¼ miles of 8 to 4-in. kal. i. mains. Report for '88 by Thos. W. Brooks. No report for '89 could be obtained.

BILLINGS, *Yellowstone Co.* (Pop., est., 3,000.) No sewers. Has electric lights.

History.—Built in '86-7 by Billings Water-Power Co., under 20-years franchise. Co. also owns and operates electric lighting plant. Des. Engr., H. W. Rowley. Const. Engr., G. E. Beach. Work let in small contracts and done by day labor.

Water Supply.—Yellowstone river; through canal, pumping direct.

Canal.—One mile long, 18 ft. wide at bottom, with 7-ft. depth of water and 12-ft. head. Furnishes power for operating two power pumps and dynamos of electric light plant.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; one Dean and one Blake dup., plunger, water-power.

Distribution.—*Mains*, kal. i., 5¼ miles. *Services*, kal. i. Pipe and specials furnished and laid by Northwestern Water & Gas Supply Co. *Taps*, 140. *Meters*, none. *Hydrants*, Ludlow, 15. *Valves*, Ludlow.

Consumption, 160,000 galls. *Pressure:* Ordinary, 50 lbs. Fire, 100 lbs.

Financial.—Cost, $60,000; includes cost of improving water-power. Bonded debt, $39,000. Int., 7%. Ann. op. exp., $1,500. Ann. rev.: consumers, $4,500; city, $1,500. Hydrant rental, $100.

Management.—Prest., Henry Belknap. Secy. and Supt., H. W. Rowley. Treas., H. H. Mund.

BOZEMAN, *Gallatin Co.* (Pop., 894; est., 4,000.) Has mining industries. Incorp. city. No sewers. Has electric lights.

History.—Built in '89 by Bozeman Water-Works Co.; put in operation Nov. 23. Engrs., Robt. Bement & Co., St. Paul, Minn., with Tracy Lyon, of the firm, in charge of construction.

Water Supply.—Lyman creek, a spring-fed mountain stream, by gravity.

Reservoir.—Cap., 1,250,000 galls.

Distribution.—*Mains*, 10 to 4-in. c. i., 7.65 miles. *Services*, w. i., lead. Pipe and specials from Shickle, Harrison & Howard Iron Co., St. Louis, Mo., and Lake Shore Foundry, Cleveland, O.; trenching and pipe-laying done by C. E. Gray, Jr., & Co. Chicago, Ill., and Robt. Bement & Co., St. Paul, Minn. *Taps*, 75. *Meters*, Hersey, 3. *Hydrants*, Mathews, 30. *Valves*, Eddy.

Pressure, 90 to 110 lbs.

Financial.—Cost, $110,000. Cap. stock, $100,000. No bonds issued. Ann. rev.: crop from land, $1,200; consumers, to date of report, $2,050; city, $3,000. Hydrant rental, $1,000; 30-years contract.

Management.—Prest., S. M. Cary. Secy. and Treas., R. B. C. Bement. Both of St. Paul, Minn. Supt., E. P. Whipple. Report, Dec. 7, '89.

BUTTE CITY, *Silver Bow Co.* (Pop., 3,363; est., 8,000.) Has extensive mining industries. Incorp. city. Has sewers and electric lights.

History.—Built in '82-3 by private Co., under supervision of O. P. Blaine.

Water Supply.—Mountain streams, by gravity from impounding reservoir to pumps, thence pumping to reservoir or direct.

Impounding Reservoir.—Cap., 20,000,000 galls.; in mountains, 10 miles from city.

Conduit.—No data.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Knowles.

Reservoir.—Cap., 210,000 galls.

Distribution.—*Mains*, 10 to 5-in. c. i., 6 miles. *Services*, iron. *Taps*, not given. *Meters*, kind not given, 3. *Hydrants*, Ludlow, 25. *Valves*, Ludlow.

Consumption, 700,000 galls. *Pressure*, 176 lbs.

Financial.—Cost, about $150,000. Debt, $22,500. Int., 7%. Ann. op. exp., $19,200. Ann. rev: consumers, $26,000; city, $4,320. Hydrant rental, $100.

Management.—Prest., Jno. Noyes. Secy. and acting Supt., J. R. Wharton. Treas., W. A. Clark.

CASCADE, *Cascade Co.* (Pop., est., 500.) Not incorp. No sewers or electric lights.

History.—Built in '89 by Perkins & Taylor; put in operation July 1. No Engr.

Water Supply.—Flowing artesian well, by gravity.

Reservoir.—Cap., about 60,000 galls.

Distribution.—*Mains*, 3½-in. steel, 3 miles. *Taps*, 35. *Hydrants*, 1.

Financial.—Cost, $7,000. Ann. rev., est., $900.

Management.—Owners, Perkins & Taylor. Report, Dec., '89.

FORT BENTON, *Choteau Co.* (Pop., est., 2,500.) No sewers. Has electric lights.

History.—Built in '87-8 by Fort Benton Water Co., under 20-years franchise. Engr. and Contr., Geo. F. Woolston, N. Y. City. Labor done by Co. Electric lighting plant in connection with water-works.

Water Supply.—Missouri river, direct pumping.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; Blake. *Boilers:* two, 50-H. P., steel.

Distribution.—*Mains*, kal. i., 5½ miles. *Services*, lead. iron. Pipe and specials from National Tube Works Co., McKeesport, Pa. *Taps* (in '87), 240. *Meters*, none. *Hydrants*, Ludlow, 25. *Valves*, Ludlow.

Consumption, 196,528 galls. *Pressure:* Ordinary, 40 lbs. Fire, 75 lbs.

Financial.—Cost, $52,000. Cap. stock, $40,000. Bonded debt, $40,000. Stock and bonds include both water and electric light works. Int., 6%. Sinking fund, 4% annually on $40,000 after '92. Ann. op. exp., $3,530. Ann. rev.: consumers, $7,200; city, $3,500. Hydrant rental, $100 for 25, $75 for additional.

Management.—Prest., Geo. F. Woolston, N. Y. City. Supt., A. D. Bigelow.

FORT KEOGH, *Custer Co.* (Pop., 700.) Military post 2½ miles from Miles City.

History.—New system built in '89 by U. S. Government. Engr., M. C. Martin, Q.-M., U. S. A. Previously, water was pumped from Yellowstone river to 8,000-gall. tank by No. 8 Blake pump.

Water Supply.—Well near Yellowstone river, pumping to tank for domestic use, and direct for fire protection and irrigating purposes.

Pumping Machinery.—Dy. cap., 500,000 galls.; Worthington. No. 8 Blake formerly used.

Tank.—Cap., 8,000 galls.

Distribution.—*Mains*, 6 and 4-in., c. i., 1¼ miles. *Hydrants*, 13.

Consumption, 20,000 galls. *Pressure*, not given.

Financial.—Cost, $10,200. Ann. op. exp., unknown. No rev.

Management.—M. C. Martin, Q.-M., U. S. A.

GREAT FALLS, *Cascade Co.* (Pop., est., 2,500.) At junction of North Fork, Missouri and Sun rivers, and at mouth of former. Incorp. city. No sewers. Has electric lights.

History.—Built in '89 by Great Falls Water Co ; put in operation Aug. 1. Des. Engr., Jno. A. Cole. Const. Engr., E. W. King, Supt.

Water Supply.—Missouri river, by direct pumping. Reservoir or stand-pipe to be added.

Pumping Machinery.—Dy. cap , 2,500,000 galls. ; two Gordon dup., 14 and 22x 11x18 ins. *Boilers:* from Mansfield (O.) Machine Works.

Distribution.—*Mains*, 12 to 4-in. c. i., 7.1 miles. *Services*, galv. i., lead. Pipe and specials from Dennis Long & Co., Louisville, Ky.; trenching and pipe-laying done by Swanson & Co., Great Falls, Mont. *Taps* (Feb. 14, '90), 114. *Meters*, none. *Hydrants*, Ludlow, 71. *Valves*, Ludlow.

Consumption, 68,000 galls. *Pressure:* Ordinary, 50 lbs. Fire, 100 lbs.

Financial.—Cost, $85,000. Cap. stock, authorized and issued, $150,000. Bonded debt, $75,000. Bonds authorized, $150,000. Int., 7%. Hydrant rental, $90 for first 75, $60 for additional.

Management.—Prest., E. G. McCoy. Secy., A. E. Deckerman. Supt., E. W. King. Reports, Oct. 2, '89, Feb. 14, '90.

HELENA, *Lewis and Clarke Co.* (Pop., 3,624; est., 13,000.) In mining region. Incorp. city. Has sewers and electric lights.

History.—Built in '87-8 by Helena Water Co., under 20-years franchise, which is owned by Turner, Clark & Rawson, Boston, Mass. Des. Engr., B. R. Clarke and Geo. E. Evans. Const. Engrs., Geo. E. Evans and J. Frank Williams. All of Boston. Contr., Geo. F. Woolston, N. Y. City. See Note.

Water Supply.—Combined surface and driven wells, pumping to reservoir. Direct pumping can be used. Well is 40½ ft. in diam., 26½ ft. deep, with 12 driven wells, 4 to 6 ins. in diam., in bottom.

Pumping Machinery.—Dy. cap., 2,800,000 galls.; two Blake dup., comp., cond. *Boilers:* two, 100-H. P., return, tubular.

Reservoir.—Cap., about 2,126,000 galls., with 18 ft. of water. In embankment, 90 x 100 ft. at bottom, with inner slopes of 1½ to 1. Bank is 21 ft. high, 81 ft. thick at bottom, and 18 at top; north bank has retaining wall of masonry in cem. High water line of reservoir is 451.04 ft. above center of pump plungers.

Distribution.—*Mains*, kal. i., 16 miles. *Services*, galv. i. *Taps*, 550. *Meters*, 20. *Hydrants*, Chapman, 115 *Valves*, 150.

Consumption, not determined. *Pressure*, 75 lbs.

Financial.—Cost, withheld, est., $200,000 Cap. stock, $300,000. Debt, withheld. Ann. op. exp., withheld, est., $14,000. Ann. rev.: consumers, withheld, est., $13,000; city, about $11,000. Hydrant rental, $100.

Management.—Prest. (May, '89), B. S. Ambler. Treas. (in '88), A. B. Turner. Supt. (in '88), A. R. Gates.

NOTE.—City has been supplied for several years by two or three other Cos., principal one being East Side Co., which has large square reservoir, tunnel 960 ft. long, and est. rev. of $5,000.

Unofficially reported in '89 that 4 Cos. had united as Helena Consolidated Water Co., with cap. stock of $1,000,000 or $1,500,000; that Geo. F. Woolston is at head of new Co. Unofficially reported, Jan., '90, that city had made 5-years contract with new Co., as follows: total present rental for 200 hydrants, $20,000, of which $2,000 is paid from general fund for flushing sewers at rate of $20 per hydrant; remainder for fire protection, at $80 per hydrant; for each additional hydrant over 200, city to pay $16.75 and $58.75 for sewerage and fire, respectively.

MISSOULA, *Missoula Co.* (Pop., est., 3,000.) On Clark's fork of Columbia river, in lumber and mineral region. Incorp. No sewers. Has electric lights.

History.—Built in '83 by Missoula Water-Works and Mining Co.

Water Supply.—Rattlesnake creek, by gravity.

Flume.—Is 2 x 3 ft.

Reservoir.—Cap., 40,000 galls.

Distribution.—*Mains*, kal. i., 7 miles. *Services*, w. i. *Taps*, 300. *Meters*, none. *Hydrants*, Ludlow, 15.

Consumption, not known. *Pressure*, 65 lbs.

Financial.—Cost, $70,000. No debt. Ann. op. exp., $1,800. Ann. rev.: consumers, $9,600; city, $2,700. Hydrant rental, about $166.66.

Management.—Prest., A. B. Hammond. Secy. and Treas., Wm. Bukford. Supt., A. Cave.

GROUP 7.—SOUTHWESTERN STATES.—Water-Works Completed, in Process of Construction or Projected, in Missouri, Arkansas, Texas, Indian Territory, Colorado and New Mexico.

MISSOURI.

Water-Works Completed or in Process of Construction.

BONNE TERRE, *St. Francois Co.* (Pop., est., 5,000.) Engaged in mining and smelting lead. Not incorp.

General Description.—Built in '87 by St. Joe Lead Co. to supply their works and the citizens, who are mostly employés of Co. Supply, Big run. 2½ miles distant, by pumping. Pump, 2,500,000-gall. Gordon. No further data.

BOONVILLE, *Cooper Co.* (Pop., 3,854; est., 5,000.) On Missouri river, in mining and quarrying region. Engaged in manufacturing and trade. Settled about 1800. Electric lights projected or under construction.

History.—Built in '83 by Boonville Water Co., under 20-years franchise. Des. Engr., P. B. Perkins, Springfield.

Water Supply.—Missouri river, pumping to reservoir and tank.

Pumping Machinery.—Dy. cap., 1,200,000 galls; two Deane and one 1,500,000 Smith & Vaile. *Boilers:* two, 60-H. P., upright, tubular.

Reservoirs.—Cap., 3,000,000 galls.; two, each 300 x 100 ft., x 10 ft. deep; 80 and 140 ft. above city; in excavation and embankment. Embankment, clay, 24 ft. wide at bottom, 8 ft. wide at top, 12 ft. high. Inner slope, 1½ to 1, lined with 3 ins. of cem. *Discharge-pipes:* four, 6 to 10 ins. in diam. Does not leak. Engr., see History.

Filter.—One in each reservoir, consisting of two brick walls, filled between with gravel.

Tank.—Cap., 60,000 galls.; 16 x 24 ft.; 50 ft. above highest reservoir.

Distribution.—*Mains*, c. i., 7½ miles. *Services*, w. i. *Taps*, 260. *Meters*, 2. *Hydrants*, Chapman, 54. *Valves*, Chapman.

Consumption, 250,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 65 lbs.

Financial.—Cost, $84,000. Cap. stock, $100,000. Bonded debt, $50,000. Int., 6%. Ann. op. exp., withheld, est., $3,000. Ann. rev.: consumers, withheld, est., $6,000; city, $3,000. Hydrant rental, $60.

Management.—Prest., Jno. S. Elliott. V. Prest., Wm. S. Stephens. Supt., R. Hodelich.

CARROLLTON, *Carroll Co.* (Pop., 2,313; est., 5,000.) Six miles from Missouri river. No sewers. Has electric lights.

History.—Built in '85 by Carrollton Water-Works Co., under 20-years franchise. Co. now controls and operates electric lighting plant.

Water Supply.—Driven wells, pumping direct and to stand-pipe.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Gaskill dup.

Stand-Pipe.—Cap., 93,000 galls.; 12 x 110 ft.; added in '90.

Distribution.—*Mains*, c. i., 2½ miles. *Services*, w. i., lead. *Taps*, 100. *Meters*, 4. *Hydrants*, Holly, Holly-Gaskill, 25.

Consumption, 100,000 galls. *Pressure:* Ordinary, 80 lbs. Fire, 130 lbs.

Financial.—Cost, $30,000. Cap. stock (Mar. 1, '90), $50,000. Debt, $25,000. Int., 7%. Ann. op. exp., $3,000. Ann. rev.: consumers, $1,500; city, $2,340. Hydrant rental, $90.

Management.—Prest., B. F. Jones. Mgr., M. Kiersted. Supt., S. K. Turner.

CARTERVLLE, *Jasper Co.* See Webb City.

CARTHAGE, *Jasper Co.* (Pop., 4,167; est., 9,500.) On Spring river. Engaged in lime and other manufacturing, and mining. Incorp. city in '72. Has electric lights.

History.—Built in '81-2 by Carthage Water-Works Co., under 20-years franchise. Engr., Jno. M. Slaney, N. Y. City. Labor done by Co.

Water Supply.—Spring river, filtered, pumping to stand-pipe and direct.

Filter.—Of stone and gravel, 25 x 50 ft., x 12 ft. deep.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; two Knowles, lifting water 170 ft.

Stand-Pipes.—Cap., 182,000 galls. *Old:* cap., 30,000 galls.; 8 x 80 ft.; plate iron; on ground 70 ft. above city; from Shickle, Harrison & Howard Iron Co., St. Louis; raised 20 ft. since construction by Jno. O'Brien Boiler Works, St. Louis, Mo. *New:* cap., 152,000 galls.; 20 x 65 ft.; on 70-ft. substructure; from Jno. O'Brien Boiler Works, St. Louis.

Distribution.—(In '87.) *Mains*, c. i., 12 miles. *Services*, w. i. Pipe and specials from Shickle, Harrison & Howard Iron Co. *Taps*, 800. *Meters*, 10. *Hydrants*, Chapman, 65. *Valves*, Chapman.

Consumption, 350,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 118 lbs.

Financial.—(In '87.) Cost, $100,000. Cap. stock, $100,000. Bonded debt, $100,000. Int., 6%. Ann. op. exp., $3,800. Ann. rev.: consumers, $7,600; city, $3,450. Hydrant rental, $50 for 60, $25 for additional.

Management.—Prest., C. H. Martin. Secy. and Treas., H. H. Harding. Supt., C. L. Bartlett.

NOTE.—No report for '89 could be obtained.

CHILLICOTHE, *Livingston Co.* (Pop., 4,078; est., 6,000.) Incorp. city. No sewers. Has electric lights.

History.—Built in '87 by Chillicothe Water, Gas & Electric Light Co., under 20-years franchise. In '89 works were in hands of receiver. Des. Engr., S. H. Lockett, N. Y. City. Asst. Engr., Jno. M. Walker, Lawrence, Kan. Contrs., Comegys & Lewis, N. Y. City.

Water Supply.—Grand river, pumping through filters to clear water reservoir, thence by repumping to stand-pipe and direct. Point of supply is two miles from town.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two 1,000,000 Worthington dup., comp., cond. *Boilers:* two, 80-H. P., steel, tubular; from Pond Engineering Co., St. Louis, Mo.

Filters.—Dy. cap., 300,000 galls.; two Hyatt.

Reservoir.—Cap., 1,250,000 galls.

Stand-Pipe.—Cap., about 125,000 galls.; 12½ x 145 ft.; from Shickle, Harrison & Howard Iron Co., St. Louis, Mo.

Distribution.—(Jan. 1, '90.) *Mains*, c. i., 8½ miles. *Services*, galv. i., lead. Pipe and specials from Shickle, Harrison & Howard Iron Co. *Taps*, 463. *Meters*, 1. *Hydrants*, Ludlow, 91. *Valves*, Ludlow.

Consumption, 90,000 galls. *Pressure:* Ordinary, 50 lbs. Fire, 150 lbs.

Financial.—(Jan. 1, '90.) Cost, $225,000. Cap. stock (in '88), $350,000. Debt, $115,000. Int., not given. No bonds issued to Feb., '88. Sinking fund, 2% after 10 years. Ann. op. exp., $4,000. Ann. rev.: consumers, $12,000; city, $3,180. Hydrant rental, $30.

Management.—Prest., G. F. Wyman. Secy. and Supt., H. G. Seymour.

CLINTON, *Henry Co.* (Pop., 2,868; est., 7,000.) Has manufactories. Incorp. Has sewers and electric lights.

History.—Built in '86 by Clinton Water Co. Engr., P. B. Perkins, Springfield.

Water Supply.—Artesian well, pumping to reservoir, stand-pipe and direct. Well is 6¼ ins. in diam., 850 ft. deep and throws a 6-in. stream 22 ft. above ground. Former source of supply was Grand river, 3 miles distant, and 6 wells.

Pumping Machinery.—Dy. cap., not given; Perkins.

Reservoir.—Cap., 2,000,000 galls.

Stand-Pipe.—Cap., 80,000 galls.; 11 x 115 ft.

Distribution.—*Mains*, 10 to 4-in., material not given, 10 miles. *Taps*, 350. *Meters*, not given. *Hydrants*, Perkins, 55.

Consumption, not given. *Pressure:* Ordinary, 60 lbs. Fire, 120 lbs.

Financial.—Cost (in '87), $96,729. Cap. stock, $100,000. Bonded debt, $75,000. Int., 6%. Ann. op. exp., withheld, est., $4,500. Ann. rev.: consumers, withheld, est., $8,000; city, $3,500 for 55 hydrants, or $63 each.

Management.—Prest., B. F. Hobart, St. Louis. Secy. and Supt., W. H. Allen.

FULTON, *Callaway Co.* (Pop., 2,409; est., 4,000.) Manufactures earthenware and fire-clay brick. Has electric lights.

History.—Built in '88-9 by city; put in operation fall of '89. Engr., Jas. Leach. Labor done by town.

Water Supply.—An 800-ft. artesian well, by gravity to reservoir for domestic use and by direct pumping for fire protection. Stand-pipe may be added.

Pumping Machinery.—Dy. cap., 1,300,000 galls; 300,000 deep-well pump made by N. O. Nelson, and 1,000,000 Deane dup., high-pressure.

Reservoir.—Cap., est., 100,000 galls.; 44 ft. square x 11 ft. deep; in excavation and embankment; probably receives water from well.

Distribution.—*Mains*, material not given, 1 mile. *Hydrants*, kind not given, 25.

Financial.—Cost, $10,000.

Management.—(In '88.) Chn. Com., W. H. Humphreys. Clerk, T. M. Bolton.

HANNIBAL, *Marion Co.* (Pop., 11,074; est., 19,000.) On Mississippi river. Engaged in river and other trade, and manufacturing. Incorp. city in '45. No sewers. Has electric lights.

History.—Built in '79-80 by Hannibal Water Co., under 20-years franchise. Des. and Consult. Engr., Chas. A. Smith, St. Louis. Const. Engr., Thos. N. Boutelle. Contr., Carroll E. Gray, Jr., Chicago, Ill.

Water Supply.—Mississippi river, pumping to reservoir. Water was originally taken from river about ¾ miles above city, passing through screen and filter wells, to combined settling and pump well.

Intake.—A 16-in. c. i. pipe, 6 ft. below surface, extended 165 ft. into river. At shore there was well provided with copper screens of ¼-in. mesh, through which water passed, and was then conveyed to filter well through 200 ft. of 16-in. c. i. pipe laid in tunnel.

Filter Well.—Here water passed through 3 ft. of sponge and 2 ft. of sand, gravel and charcoal, before reaching the main well. In '80 filter had dy. cap. of 300,000 galls. Provision was made for taking water directly from river.

Settling Well and Pump-Well.—Is 40 ft. in diam. at top, 38 at bottom, 30 ft. deep, with its bottom 10 ft. below low water.

Pumping Machinery.—Dy. cap., 4,000,000 galls.; 1,500,000 Blake dup. and 2,500,000 Allis.

Reservoir.—Cap., 1,500,000 galls.; has semicircular ends, and is 122 x 194 ft. at the top, 68 x 140 ft. at bottom, 210 ft. above city, 230 ft. above low water, and 1,000 ft. from pumping station. Inlet and outlet pipes enter the reservoir from the same side, each joint being encased with stone walls, and the space between filled with clay puddle.

Distribution.—*Mains*, c. i., 14½ miles. *Services*, lead. *Taps*, 800. *Meters*, 24. *Hydrants*, Mathews, 82.

Consumption, 750,000 galls. *Pressure:* Ordinary, 90 lbs. Fire, 125 lbs.

Financial.—(In '87.) Cost, $128,000. Debt, $105,000 Int., 8%. Ann., op. exp., $5,700. Ann. rev.: consumers, withheld, est., $15,000; city, $5,000. Hydrant rental, $75 and $60.

Management.—Prest., E. Whittaker. Secy. and Treas., Horatio D. Wood. Supt., Chas. T. Lewis.

HOLDEN, *Johnson Co.* (Pop., 2,014; est., 4,500.) Incorp. Has sewers. No electric lights.

History.—Built in '87 by Holden Water-Works Co., under 20-years franchise, with privilege of renewal unless city buys works. Des. Engr., Galen W. Pearsons, Kansas City. Const. Engrs., L. P. Andrews and J. B. Quigley. Contrs., Inter-State Gas & Water-Works Co., St. Louis. Works sold in '89 under foreclosure of holders of first mortgage bonds; bought by Jno. Platt for $40,500.

Water Supply.—Impounding reservoir, pumping through filter to stand-pipe.

Reservoir.—Not described.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Deane dup., comp. *Boilers:* steel.

Filters.—Dy. cap., 200,000 galls.; Hyatt.

Stand-Pipe.—Cap. about 75,000 galls.; 10 x 127 ft.; from Jno. O'Brien Boiler Works Co., St. Louis.

Distribution.—*Mains*, c. i., 6¼ miles. *Services*, galv. i., lead. Pipe and specials from South St. Louis Foundry. *Taps* (in '88), 46. *Hydrants*, Chapman, 50. *Valves*, Chapman.

Consumption, 23,500 galls. *Pressure*, 60 lbs.

Financial.—Cost, $65,000. Previous to foreclosure sale (see History) cap. stock was $75,000, and bonded debt $75,000; int., 6%. Ann. op. exp., $3,000. Ann. rev.: consumers, $300; city, $3,000. Hydrant rental, $60.

Management.—Prest. Thos. Platt, St. Louis. Secy., A. Schenk. Supt., B. J. Miller.

INDEPENDENCE, *Jackson Co.* (Pop., 3,146; est., 7,500.) On Missouri river, 1,027 ft. above sea. Has various manufactories. Settled in '27. Incorp. No sewers. Has electric lights.

History.—Built in '83-4 by Independence Water Co., under 20-years franchise. Engr. and Contr., P. B. Perkins, Springfield, Mo.

Water Supply.—Missouri river, filtered, pumping to reservoir.

Pumping Machinery.—Dy. cap. (furnish dy. supply of, not counting repumping), 1,000,000 galls.; Smith & Vaile.

Reservoirs.—Water is pumped to reservoir 30 ft. above river, in two compartments, one serving as settling basin and other for storage, with filter of sand enclosed by masonry walls between them. Water is then repumped to another reservoir, 390 ft. above first, and from this repumped to tank described below. Cap., not given; 60 x 30 ft.

Tank.—Cap., 60,000 galls.; 24 x 18 ft.; wood, on brick tower.

Distribution.—*Mains*, c. i. 8¼ miles. *Services*, w. i., lead. Pipe and specials from Ripley & Bronson, St. Louis, Mo. *Taps*, 350. *Meters*, kind not given, 7. *Hydrants*, Chapman, 50. *Valves*, Chapman.

Consumption, 300,000 galls. *Pressure:* Ordinary, 25 lbs. Fire, 100 lbs.

Financial.—Cost, $90,000. Cap. stock, $100,000. Bonded debt, $60,000: $10,000 at 8, $50,000 at 7%. Ann. op. exp., $5,000. Ann. rev.: consumers, $4,500; city, $4,000. Hydrant rental, $80.

Management.—Prest., W. E. Winner. Secy., C. S. Crysler. Supt., R. D. Wirt.

JEFFERSON BARRACKS, *St. Louis Co.* (Pop., 700.) A military post, near St. Louis.

General Description.—Built in '88 by U. S. Government. Chf. Engr., Thos. J. Whitman. Asst. Engr., Chas. H. Leddie. Contr., John Patrick O'Donnell. All of St. Louis. A 6-in main leads from St. Louis water-works to distribution system at post. Cost, $10,725. Other details not given. Report for '88 by Deputy Qr. M. Genl. U. S. A., St. Louis, Mo. No report for '89 could be obtained.

JEFFERSON CITY, *Cole Co.* (Pop., 5,271; est., 7,000.) On Missouri river in lumber and mining district. Incorp. city. Has sewers and electric lights.

History.—Built in '88 by Co., under 20-years franchise. Engr., J. B. Johnson, St. Louis. No Contrs. for labor.

Water Supply.—Missouri river, pumping to aerating and settling basins, from which water flows to clear water basin; thence repumped to stand-pipe or direct.

Pumping Machinery.—*Low Service:* dy. cap., 2,000,000 galls. *High Service:* dy. cap., 2,000,000 galls. In all, four 1,000,000 Gordon & Maxwell comp., dup. *Boilers:* two, 100-H. P., Heine safety.

Aerating and Settling and Clear Water Basins.—*Aerating and Settling:* cap., 500,000 galls.; masonry 125 ft. above river; 20 ft. deep; water enters by passing downward through flaring pipe, containing bent tubes through which air is drawn; basin is subdivided by vertical and horizontal partitions to facilitate settlement.

Clear Water: cap., 300,000 galls.; brick, circular, 20 ft. deep.

Conduit.—Diam., 14 ins.; from clear water basin to high-service pump.

Stand-Pipe.—Cap., 200,000 galls.; 20x125 ft.; from Palmer & Son, Kansas City.

Force Main.—Diam., 14 ins.

Distribution.—*Mains*, 14 to 4-in. c. i., 8½ miles. *Taps*, 150. *Meters*, 12. *Hydrants*, White, 72. *Valves*, Peet.

Consumption, 385,000 galls. *Pressure*, not given.

Financial.—Cost, $149,000. Bonded debt, $100,000. Int., 5%. Ann. sinking fund, $1,000. Ann. op. exp., $3,200. Rev. (for 7 months): consumers, $7,560; city, $3,000, Hydrant rental, $45.

Management.—Prest., F. H. Bindler. Supt., Jno. Edwards. Report, June 24, '89.

JOPLIN, *Jasper Co.* (Pop., 7,038; est., 10,000.) On uneven ground in lead and zinc mining region. Has manufactories. Settled in '71. Incorp. in '73. No sewers. Has electric lights.

History.—Built in '80 by Joplin Water Co., under 20-years franchise. Des. Engr., P. B. Perkins, Springfield, Mo.

Water Supply.—Shoal creek, pumping to reservoir. Creek is 3¾ miles distant, and rises 50 miles away in Ozark Mts.

Pumping Machinery.—Dy. cap., 864,000 galls.; Smith & Vaile.

Reservoir.—Cap., 3,000,000 galls.; 220 ft. above pump, 82½ ft. above city; in embankment, lined with stone in cem

Distribution.—*Mains*, c. i., 14 miles. *Services*, w. i., lead. *Taps*, 674. *Meters*, 10. *Hydrants*, Ludlow, 60.

Consumption, 450,000 galls. *Pressure:* Ordinary, 30 to 60 lbs. Fire, 100 lbs.

Financial.—Cost, $124,000. Cap. stock, $124,000. Bonded debt, $75,000. Int., 7%. Ann. op. exp., $4,750. Ann. rev.: consumers, $10,504; city, $5,000. Hydrant rental, $83.33.

Management.—Thos. Connor. Secy. and Supt., C. W. Glover. Treas., Jno. F. Wise.

KANSAS CITY, *Jackson Co.* (Pop., 55,785; est., 110,000. Est. pop. supplied, 130,000.) At junction of Kansas and Missouri rivers, on bottom land, undulating land rising back of this which varies in elevation from 75 to 260 ft. At south, Turkey creek empties into Kansas river, forming natural sewer outlet for city. Has sewers and electric lights.

Kansas City, Kan., joins city on south and west. This municipality now includes old Kansas City, Wyandotte, Armstrong, River View and Armourdale, all Kansas towns, and all but first being between the two rivers.

History.—Built in '73, when the pop. was about 40,000, by National Water-Works Co. Later, system was extended to Kansas City, Kan., under 20-years franchise granted to Kansas City Water Co., of Kansas, management of two Cos. being same. Since '84, franchises and plant of Wyandotte-Armourdale Water Co. have been secured by National Water-Works Co. In '86-7 important extensions and improvements were made by latter Co. Galen W. Pearsons, Kansas City, has been Des. and Const. Engr. since works were started. Labor done by Co.

Old works at Wyandotte were built in '84 by Wyandotte Water Co., under 20-years franchise, and soon extended to Armourdale under similar franchise granted to Armourdale Water Co. Later, two Co.s were merged in one. Wyandotte plant has been connected with new works, but will be used only in emergency.

Water Supply.—Missouri river, mainly by direct pumping. Water is first pumped to Quindaro settling basins and flows thence by gravity to tank at intermediate Kaw point pumping station and to original pumping station at Turkey creek. Kaw point station is auxiliary to first or Turkey creek plant, and supplies Kansas City, Kan., by pumping from tank back to old Wyandotte stand-pipe, and also fills lower levels of Kansas City, Mo., by direct pumping, and also old reservoir on hill in Kansas City, Mo., thus leaving full cap. of first plant for high service supply of Kansas City, Mo. When Kaw point pumps draw so heavily upon supply as to diminish gravity flow to Turkey creek station this is accelerated by pumping. Basins constructed at Turkey creek station for settling purposes are now used for storage, and water is pumped from them directly to mains for high service.

Supply was taken from Kansas river at Turkey creek station until completion of new pumping works built in '86-7.

QUINDARO WORKS.

Intake Crib.—Located at point above Wyandotte, and east of Quindaro, where shore has protection put in by U. S. Government, consisting of willow mattress and riprap extending from top of banks to nearly full depth of stream, being about 150 ft. wide and reaching a depth of 15 ft. at low water. In constructing crib, riprap was cleared away and grillage sunk to conform with surface of mattress, grillage forming bottom of inlet crib, and timber work of oak and yellow pine being built up from this to within 2 ft. of low water mark. Remainder of crib is of heavy masonry, wells containing gates and screens to admit water from any height.

Siphon.—Leads from inlet crib to pump-well, 745 ft., and is of 42-in. pipe, first 75 ft. from river being of w. i., and remainder of c. i., with lead joints. Center of siphon is 10 ft. above low water, most of rise being at river and for remaining distance but 6 ft. in 100. Soil is alluvial, and bottom of trench was made 6 ft. wide, then cross-planked.

Pumps.—Dy. cap., 18,000,000 galls.; two sets of Holly-Gaskill pumps lift water to settling basins.

Settling Basins.—Cap., 60,000,000 galls. Four basins in embankment on alluvial bottom land, which is 27 ft. above datum. Top of banks is 50 ft. above datum. One end is straight, other semi-circular. Outer slopes are 1½ to 1, and inner, 2 to 1. Outer bank is 74 ft. thick at bottom, of heavy clay from adjacent bluffs.

River side of basins is guarded with riprap, and others have slight retaining walls; bottom is covered with 2 ft. of clay, put down in thin layers, dragged and rolled, and upon this and inner slopes of banks was placed a layer of concrete, topped with smooth coat of cem. Concrete is 4 ins. thick on bottom and 5 on slopes.

Interior walls are of masonry, on grillage of 8x10-in. timbers, 14 ft. long, spaced 10 ins. apart, and laid on 10x10-in. longitudinal timbers, whole bedded in concrete. In each of interior walls, and in part of east or straight bank are two 3x6¼-ft. conduits, through which water flows from one basin to another. Bottom of center basin has slope of 10%; of the others, from 5 to 3%. Depth of water varies from 20 to 30 ft., except at east end of center basin, which is shallower, inlet discharging in center of this, and spreading over its bottom.

Conduit.—A 36-in. pipe, with dy. cap. of 16,000,000 galls., leads to Kaw point station and beyond this to the old station at Turkey creek.

KAW POINT WORKS.

Receiving Tank.—Cap., 320,000 galls.; 50x27 ft.

Pumping Machinery.—Cap., not given; Worthington dup., comp., cond., with 25 and 43.3 in. steam cylinders and 26-in. water plunger, all of 48-in. stroke. *Boilers:* four 200-H. P. Heine safety.

Wyandotte Stand-Pipe.—Dy. cap., 350,000 galls.; 25x100 ft.

River Crossing.—Two pipes are carried across Kansas river on a bridge; pipe also crosses bridge at Turkey creek station.

Reservoir.—Cap., 9,000,000 galls.; area, 2½ acres; depth of water, 21 ft.; water, 4 ft. below top of embankments; 232 ft. above river; in excavation, 13; in embankment, 12 ft. Banks of clay, outer part mixed with loam; without heart-wall; 10 ft. wide on top, 85 at bottom. Inner slope, 1½ to 1, covered over lower half with 9 ins. of concrete, upper roughly paved with limestone rubble. *Discharge-pipe:* 20-in. Some seepage through upper part of bank, lately caused by crawfish boring above concrete. Built in '74. Engr., see History. Contr., Thos. Corrigan.

TURKEY CREEK WORKS.

Reservoir.—Originally built for settling basin with cap. of 7,000,000 galls., and afterward enlarged to 18,000,000 galls. Since completion of new pumping plant, this has been used as storage and receiving reservoir, from which water is pumped directly to mains for high service in Kansas City.

Pumping Machinery.—The first pumps here were 10-in. Holly quadruplex of 30-in. stroke. To these were added a 5,000,000-gall. Holly quadruplex and an 8,000,000-gall. set of low-lift pumps. Present pumps are not described, but they are either of the Holly or Worthington type.

The remaining data applies to Kansas City, Mo.

Distribution.—*Mains*, c. i., 85 miles. *Services*, galv. i., lead. *Taps*, 10,436. *Meters*, 1,000. *Hydrants*, Holly. Mathews, Ludlow. 1,087. *Pressure-recording gauge*, Edson.

Consumption, 10,000,000 galls. *Pressure:* Ordinary, 130 lbs. Fire, 135 to 170 lbs.

Financial.—Cost (in '87), $4,500,000. Cap. stock (in '88), $3,000,000. Bonded debt, $3,000,000 Int., 6%. Ann. op. exp. (in '87), $56,283. Ann. rev.: total (in '87), $392,764. Hydrant rental, $40, $60 and $80.

Management.—Prest., Geo. E. Taintor. Secy. and Treas., R. N. Weems. Both of 102 Broadway, N. Y. City. Cashier, Geo. B. Wing. Supt., B. F. Jones. Asst., Fred Wing. Chf. Engr., F. E. Sickles.

NOTE.—An extended description of these works, with illustrations, is given in *Engineering News*, vol. XVIII., pp. 328-9, 345-6, 380, 400, 437, 451-5. These articles were written by Galen W. Pearsons, who was Des. and Const. Engr. of the works. This description includes some parts of the old works not now in use, especially first intake syphon and pump-well.

LEXINGTON, *La Fayette Co.* (Pop., 3,096; est., 5,000.) On Missouri river, in coal region, upon a high bluff. Engaged in manufacturing and trade. No sewers Has electric lights.

History.—Built in '84-5 by Lexington Water Co., under 20-years franchise. Const. Engr., Jos. Simmons. Contr., J. A. Jones.

Water Supply.—Missouri river, pumping to settling reservoirs, then re-pumping to tank.

Pumping Machinery. Dy. cap., 300,000 galls.; two 1,500,000 Blake. *Boilers:* two Root safety.

Settling Reservoirs.—Two, ½-mile from river, under bluff and near pump.

Stand-Pipe.—Cap., 300,000 galls.; 18 ft. x 152 ft.; from E. E. Palmer & Son, Kansas City.

One stand-pipe burst just after its erection, when full of water. This was on six 50-ft. c. i. columns, pipe being 22 ft. in diameter, 152 ft. high. It was paid for by Abendroth & Root, N. Y. City.

Distribution.—*Mains*, spiral riveted w. i., 8 miles. *Services*, galv. i., lead. *Taps*, 342. *Meters*, Crown, 15. *Hydrants*, White, 50.

Consumption, 160,000 galls. *Pressure:* Ordinary, 65 lbs. Fire, 100 lbs.

Financial.—Cost, $93,000. Cap. stock, $100,000. Bonded debt, $75,000. Int., 6%. Ann. op. exp., $3,600. Ann rev.: consumers, $4,500; city, $4,000. Hydrant rental, $80.

Management.—Prest., Wm. Morrison. Secy. and Treas., Jas. Wentworth. Supt., E. W. Abendroth.

LOUISIANA, *Pike Co.* (Pop., 4,325; est., 5,500.) On Mississippi river, in Buffalo township. Engaged in manufacturing. Has electric lights.

History.—Built in '87-8 by Louisiana Water Company, which is controlled by American Water-Works and Guarantee Co., Ltd., Pittsburgh, Pa.; put in operation about March 1, '88. Contr. for labor, A. W. Stevens, Logansport, Ind.

Water Supply.—Mississippi river, filtered, pumping, through mains to reservoir.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; two 750,000 Walker.

Filters.—Dy. cap., not given; National.

Reservoir.—Cap., 1,200,000 galls.; 305 ft. above low water in river.

Distribution.—*Mains*, 12 to 4-in. c. i., 6½ miles. *Services*, galv. i. Pipe and specials from National Foundry & Pipe Works, Scottdale, Pa. *Hydrants*, Ludlow, 55. *Valves*, Ludlow.

Pressure: Ordinary, 80 lbs. Fire, 100 lbs.

Financial.—Cost, about $75,000. Cap. stock, $100,000. Hydrant rental, $50.

Management.—Prest., J. H. Purdy. Secy. and Treas., W. H. Kuhn, Pittsburgh, Pa. Supt., S. B. Culver.

MARSHALL, *Saline Co.* (Pop., 2,701; est., 4,500.) Incorp. No sewers or electric lights.

History.—Built in '85 by Marshall Water Co., under 20-years franchise. Des. Engr., Galen W. Pearsons, Kansas City. Const. Engr., P. B. Perkins.

Water Supply.—Well, 30 ft. in diam., by direct pumping.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two Worthington. *Boilers:* 35-H. P., tubular.

Distribution.—*Mains*, c. i., 5 miles. *Services*, w. i. Pipe and specials from and laid by National Water Works Co. *Taps*, 125. *Meters*, none. *Hydrants*, Ludlow. 67. *Valves*, Ludlow.

Consumption, 250,000 galls. *Pressure:* Ordinary, 80 lbs. Fire, 130 lbs.

Financial.—Cost, $75,000 Cap. stock, $75,000. Bonded debt, $75,000. Int., 6%. Ann. op. exp., about $2,500. Ann. rev.: consumers, about $2,300; city, $5,025. Hydrant rental, $75.

Management.—Prest., Jno. R. Hall. Secy., C. L. Hall. Supt., E. R. Parr.

MARYSVILLE, *Nodaway Co.* (Pop., 3,485; est., 5,000.) Incorp. No sewers. Has electric lights.

History.—Built in '86 by Municipal Investment Co., under an exclusive 20-years franchise. Engr. and Contr., A. H. McCormick, Parsons, Kan.

Water Supply.—One Hundred and Two river, pumping to stand-pipe and direct.

Pumping Machinery.—Dy. cap., 2,225,000 galls.; one 1,500,000 Smith & Vaile. *Boilers:* two, 80-H. P.

Stand-Pipe.—Cap., 250,000 galls.; 18½x135 ft.

Distribution.—*Mains*, c. i., 8¼ miles *Services*, galv. i. Trenching and pipe-laying done by C. M. Davison, Pittsburg, Kan. *Taps*, 135. *Meters*, 27. *Hydrants*, White. 51. *Valves*, Peet.

Consumption, 200,000 galls. *Pressure*, 55 lbs.

Financial.—Cost, $85,000. Bonded debt, $75,000. Int., 6%. Ann. op. exp., $1,440. Ann. rev.: consumers, $1,900; city, $3,468. Hydrant rental, $68.

Management.—Prest., Wm. O. Cole. Supt. and Secy., C. P. Denny.

MEXICO, *Audrain Co.* (Pop., 3,835; est., 7,000.) On Salt river. Manufactures plows and wagons. Incorp. No sewers. Has electric lights.

History.—Built in '84-5 by Mexico, Mo., Water-Works Co., under a 20-years franchise. Des. Engr., C. S. Masten, Phœnix, Ariz. Const. Engr., W. C. Masten. Contrs., Pond & Masten.

Water Supply.—Springs and surface water, filtered, by direct pumping.

Pumping Machinery.—Dy. cap., 1,750,000 galls.; Blake. *Boilers:* tubular. Both from Pond Engineering Co., St. Louis.

Filter.—Dy. cap., not given; National.

Distribution.—(In '88) *Mains*, c. i., 4.8 miles. *Services*, galv. i., lead. *Taps*, 200. *Meters*, 4. *Hydrants*, Chapman, 45. *Valves*, Chapman.

Consumption, 250,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 130 lbs.

Financial.—(In '87.) Cost, $80,000. Cap. stock, $60,000. Bonded debt, $60,000. Int., 4.16%. Ann. op. exp., $3,000. Ann. rev.: consumers, $3,600; city, $3,600. Hydrant rental, $80.

Management.—Prest., G. B. Macfarlane. Secy., J. F. Llewellyn. Treas. and Supt., Jno. J. Steele.

MOBERLY, *Randolph Co.* (Pop., 6,070; est., 10,000.) Incorp. Has sewers and electric lights.

History.—Built in '85 by Moberly Water-Works Co., under 20-years franchise.

Water Supply.—Surface water, by direct pumping from reservoir.

Dam and Reservoir.—Cap., not given; area, 27 acres; depth 33 ft. Dam, not described.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; two Worthington. *Boilers:* two 4 x 14-ft. tubular.

Distribution.—*Mains*, c. i., 6½ miles. *Services*, lead. *Taps*, 305. *Meters*, 14. *Hydrants*, Chapman, 70.

Consumption, 350,000 galls. *Pressure:* Ordinary, 75 lbs. Fire, 130 lbs.

Financial.—Cost, $100,000. Cap. stock, $20,000. Bonded debt, $100,000. Int., 6%. Ann. op. exp., $3,600. Ann. rev.: consumers, $5,000; city pays int. on bonds, $6,000, for hydrant rental, or $85.71 each.

Management.—Prest., D. S. Torney. Secy., A. O. Keefe. Treas., O. E. Hannah. Supt., Jno. Floyd.

NEVADA, *Vernon Co.* (Pop., 1,913; est., 9,000.) Has electric lights.

History.—Built in '85 by Nevada Water Co., under 20-years franchise.

Water Supply.—Marmaton river, pumping to reservoir.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; Deane.

Reservoir.—Is 150 ft. sq.

Distribution.—(In '87.) *Mains*, c. i., 10 miles. *Services*, w. i. *Taps*, 500. *Meters* not given. *Hydrants*, kind not given, 66.

Consumption, not given. *Pressure:* Ordinary, 35 lbs. Fire, 100 lbs.

Financial.—(In '87.) Cost, $77,000. Cap. stock, $100,000. Bonded debt, $50,000. Int., not given. Ann. op. exp., withheld, est., $6,000. Ann. rev.: consumers, withheld, est., $12,000; city, $3,300. Hydrant rental, $50.

Management.—(In '88.) Prest., C. H. Malin. Supt., C. B. Ingels.

NOTE.—No report for '89 could be obtained.

PIERCE CITY, *Lawrence Co.* (Pop., 1,350; est., 4,000.) Has electric lights.

History.—Built in '88 by J. Guinney. Des. Engr., Jno. W. Nier. Const. Engr., S. Jobe. Both of Kansas City. Labor done by day.

Water Supply.—Guinney's lake, by gravity to stand-pipe.

Stand-Pipe.—Cap., 100,000 galls.; 15x75 ft.

Distribution.—*Mains*, 6 miles. *Hydrants*, 25.

Consumption, 50,000 galls. *Pressure*, not given.

Financial.—Cost, $45,230. Bonded debt, $25,000. Int., 6%. Ann. op. exp., about $960. Ann. int., $1,500. Ann. rev.: consumers, $1,540; city, $1,750. Hydrant rental, $70 for 25, $50 for additional.

Management.—Prest. and Mgr., J. Guinney. Secy. and Treas., G. N. Bennett.

RICH HILL, *Bates Co.* (Pop., est., 6,000.) On prairie. Engaged in coal mining and zinc smelting. Settled in '80. Incorp. No sewers. Has electric lights.

History.—Built in '83 by private Co., under 20-years franchise. Engr., F. Wm. Raeder, St. Louis.

Water Supply.—Marais des Cygnes river, through Hyatt filter to well, thence by direct pumping.

Filter.—Dy. cap., 1,000,000 galls.; Hyatt; built in '86.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; two dup. *Boilers:* Jarvis. All from Pond Engineering Co., St. Louis.

Distribution.—*Mains*, c. i., 9½ miles. *Services*, w. i. *Taps* (in '87), 70. *Meters*, 8. *Hydrants*, Ludlow, 50. *Valves*, Ludlow.

Consumption, 200,000 galls. *Pressure:* Ordinary, 45 lbs. Fire, 90 lbs.

Financial.—Cost, $90,000. Bonded debt, $85,000. Int., 6%. Ann. op. exp. (in '87), $5,000. Ann. rev.: consumers, $3,400; city, $4,500. Hydrant rental, $90.

Management.—Prest., D. E. Garrison, St. Louis. Supt. and Secy., E. A. Slater.

SAINT CHARLES, *St. Charles Co.* (Pop., 5,014; est., 7,500.) On Missouri river, business portion lying on plateau about 15 ft. above high water, 400 to 500 ft. wide, back of which ground rises about 200 ft. in 1¼ miles. Difference between high and low water is about 40 ft. Settled about 1760. Incorp. third-class city. No sewers or electric lights.

History.—Built in '81 by St. Charles Water & Heating Co., under 20-years franchise. Des. Engr., Chas. A. Smith, St. Louis. Const. Engr., J. T. Jones. Contr., Carroll E. Gray, Jr., Chicago, Ill.

Water Supply.—Missouri river, pumping to settling tanks, thence by repumping to tank and direct. In '89 stand-pipe was projected; steel, 25 x 80 ft.

Intake Pipe.—Of 12-in. pipe, from point in river 8 ft. below low water, to pump-well. First 200 ft. is perforated w. i. pipe with flanged joints, and remaining 600 ft. of c. i.

Pump-Well.—Masonry, 25 ft. sq. and 30 ft. deep from surface of bank.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; Worthington. These are [probably] used for repumping, as in '82 a 2,000,000 Knowles-Cornish pump lifted water from well to settling tanks. Steam cylinders were at surface and water cylinders at bottom of well.

Settling Tanks.—Cap., 860,000 galls.; two, plate iron, each 70 ft. in diam., 15 ft. deep, set on masonry bed 80 x 160 ft., on edge of bank, 10 ft. above high water.

Distributing Tank.—Cap., 200,000 galls. In '82 circular wooden tank was in use; this was 20 x 16 ft., on brick tower 25 ft. sq. and 40 ft. high, built on hill back of city, water level in tank being 318 ft. above low water in city. Bottom of tank was placed on timber trussed beams, and further supported by timber trestle built in center of tower. Trestle was not part of original design. All timber was treated by Thilmany process, and hot paraffine applied to brickwork. It is unofficially reported that this tank burst in '89.

Distribution.—*Mains*, c. i., 7½ miles. *Services*, iron. *Taps*, 325. *Meters*, 2. *Hydrants*, Ludlow, 40. *Valves*, Eddy.

Consumption, 400,000 galls. *Pressure:* Ordinary, 87 lbs. Fire, 120 lbs.

Financial.—Cost, $80,000. Cap. stock, $80,000. Bonded debt, $80,000. Int., 6%. Ann. op. exp. (in '87), $3,240. Ann. rev.: consumers (in '87), $1,000; city (in '87) $3,600. Hydrant rental, $90.

Management.—Prest., E. Richards. Treas., J. W. Goddard. Supt., W. L. Vick.

SAINT JOSEPH, *Buchanan Co.* (Pop., 32,431; est., 78,000.) On Missouri river on bottom land, bluff at this point being about 5 miles from river. Settled in '43; incorp. city in '50. Has electric lights.

History.—Built in '80 by St. Joseph Water Co., under 20-years franchise and hydrant contract. Engr., Jno. W. Rutherfoord, N. Y. City.

Water Supply.—Missouri river, pumping to reservoir. Point from which supply is taken is 3 miles from city, by land, and 10 miles by water, owing to bend in river.

Pumping Machinery.—Dy. cap., 8,000,000 galls.; two 3,500,000 and one 1,000,000 Worthington horizontal, dup., comp., cond.

Force Main.—In '82 this was a 16-in. c. i. pipe, 1,196 ft. long, rising 320 ft. between pumps and reservoir.

Reservoir.—Cap., 22,000,000 galls.; in two compartments, in excavation and embankment, with inner slopes lined with one course of brick laid on 18 ins. of puddle. Water settles in first basin then passes to second.

Supply Main.—Of 20-in. c. i., 2½ miles long.

Distribution.—(In '87.) *Mains*, 24 to 4-in. c. i., 32 miles. *Services*, lead. Pipe and specials from Cincinnati & Newport Iron & Pipe Co., Newport, Ky. *Taps*, withheld, est., 3,000. *Meters*, Crown, number not given. *Hydrants*, Mathews, 250. *Valves*, Ludlow.

Consumption, not given. *Pressure*, 70 to 115 lbs., according to elevation.

Financial.—(In '87.) Cost, not given, est., $800,000. Cap. stock, $460,000. Bonded debt, $400,000: $100,000 at 10, $300,000 at 6%. Ann. op. exp., withheld, est., $20,000. Ann. rev.: consumers (for '85), $80,000; city, $21,400. Hydrant rental, $100 for 160. $60 for additional.

Management.—(In '88.) Prest., Jas. M. Barnes. Secy., L. C. Barnes. Supt., T. J. Chew, Jr.

NOTE.—No report for '89 could be obtained.

SAINT LOUIS, *St. Louis Co.* (Pop., 350,518; est., 400,000.) On Mississippi river, covering area of over 60 sq. m. and having about 13 miles of river frontage. Ground rises from river quite rapidly, and valley of Mill creek divides city into two parts, northern rising 140 and southern 155 ft. above river. Founded in 1764; incorp. city in '22. Has sewers and electric lights.

History.—Owned by city. First works built in '30. New works begun in '65 and different parts finished in '73 and '83. An extension of low service estimated to cost from $3,000,000 to $4,000,000 was begun in '88. Works built in '65-71 were designed by Jas. P. Kirkwood, with Col. Henry Flad, now Prest. Board Public Works, as principal assistant.

For description of works from '30 to '65, see MANUAL for '88, p. 471.

Water Supply.—Mississippi river, pumping to settling basins, thence repumped through stand-pipes and distributing system to reservoir.

Intake Cylinder.—C. i., sunk in river to bed rock, and provided with screens so water can be taken at any depth. Generally water is taken 5 ft. below surface, where it has been found to be freest from floating impurities, and from sediment near bottom.

Intake-Pipe.—Diam., 66 ins.

Pump-Well.—Masonry, built on coarse unyielding sand, which is confined by sheet-piling, driven 12 ft. below bottom of well, or 25 ft. below lowest water level in river. Well is near river, and bank at this point is covered with riprap.

Pumping Machinery.—Divided into high and low, and temporary low service, first low service lifting water to settling basins, and high service re-pumping. Water is lifted from 15 to 50 ft., according to stage of river, and cap. of pumps depends upon condition of water.

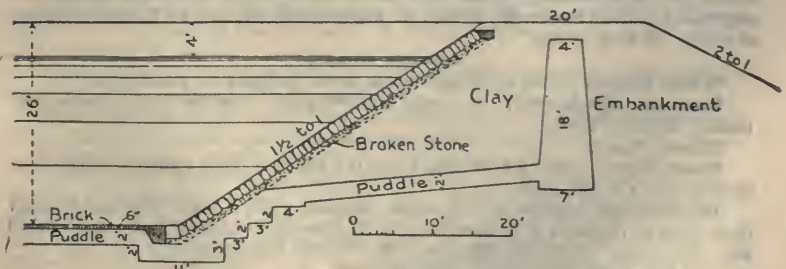
Low Service: Dy. cap., 49,000,000 galls.; two 16,000,000 Cornish bull, and one 17,000,000 beam and fly-wheel double plunger pumping engines.

Temporary Low Service: Dy. cap., 20,000,000 galls.; four 5,000,000 Worthington dup., non-cond.

High Service: Dy. cap., 63,000,000 galls.; three 15,000,000 single, and one 18,000,000-gall. double comp., beam and fly-wheel pumping engines; large high-pressure beam engine was built in '88 by Fulton Iron Works, St. Louis, but it is not stated whether this is one of above.

Settling Basin.—Cap., about 100,000,000 galls. Located 365 ft. from engine house. Four basins, each 278 x 600 ft., x 19 ft. deep. Sides lined with squared stone range masonry, 9 ft. thick at bottom and 4 at top, reinforced every 7 ft. by 3x4-ft. buttresses.

These walls rest on foundations of timber and concrete, so distributed that load shall not exceed 200 lbs per sq. ft., as soil is loose alluvium of river bottom. Walls are backed with puddling. Partition walls are 11 ft. thick at bottom and 8 ft. at top. Bottom is paved with brick on edge, and slopes toward center and river.



Compton Hill Storage Reservoir, St. Louis, Mo.

One basin is drawn from while two are settling and another filling, or one settling and another being cleaned. Each basin is cleaned about once in 4 months, in which time about 16 ins. of sediment has been collected. In '78, 184,000 cu. yds. were taken from basins at cost of $.0105 per cu. yd., and in '79, 140,000 at $.0084.

Conduits, clear water-well, screen chamber and pump-well: Brick conduit 1,100 ft. long leads to well 100x300 ft., x 17 ft. deep, from which an 8x13-ft. brick conduit leads to screen chamber, 9x50 ft. From latter three 60-in. pipes lead to pump in dry well, 12x87 ft., and 39 ft. below high service engine-house floor.

Stand-Pipes.—Two. No. 1 being 5 ft. in diam. and No. 2 6 ft., and both 160 ft. high.

Compton Hill Storage Reservoir.—Cap., about 60,000,000 galls.; 540 x 570 ft. at water surface x 22 ft. deep. See accompanying section of embankment. Full water level is 170 feet above city directrix, or base of levels, which is 33.83 ft. above low water of Dec. '63, and and 7.58 below high water of June, '44.

Distribution.—*Mains*, c. i., 336 miles. *Services*, lead. Pipe and specials for extensions from Shickle, Harrison & Howard Iron Co., St. Louis, Mo., and South St. Louis Foundry. *Taps*, 36,237. *Meters*, 2,840. *Hydrants*, 3,366. Hydrants and valves are of special designs, hydrants on extension being made by St. Louis Iron and Machine Works, and stop valves by Fulton Iron Works, St. Louis. *Close of* '80: Mains, 212 miles. Taps, 20,204. Meters, 573. Hydrants, 1,842. No data for earlier years.

Consumption, 32,000,000 galls. *Pressure*, av., 40 lbs.

Financial.—Cost, $13,345,000. Debt, $5,200,000. Int., 6%. Ann. op. exp., $318,981. Ann. rev.: consumers, $952,689.

From May, '30, to May, '67, when works passed into hands of Comrs., works cost $2,421,070, and the rev. had been $2,096,278. On completion of new works in '71, old works and their operation had cost $2,980,000, and the revenue had been $3,780,000.

Rev. for '60, $114,760; do., '70, $335,626; do., '80, $660,024. Cost for corresponding years not known.

Management.—Water Comr. (Chf. Engr.), M. L. Holman. Assessor and Collector, Jos. Temple. Chf. Mech. Engr., Aug. W. Grote. Asst. Engr. in charge of distribution, S. B. Russell.

References.—For account of "Lowering a Large Main while in Use," by S. Bent Russell, see *Eng. News*, Vol. XIII., p. 241, and for cuts of engine known as High Service No. 5, and specifications for same, see same journal, Vol. XVI., pp. 84, 93.

"Clearing Water by Settlement; Observations and Theories." with illustrations and diagrams. By Jas. A. Seddon. *Eng. News*, Vol. XXII., pp. 607-9, Vol. XXIII., pp. 31-3, 98-9. This paper was compiled by the author from his "Report on the Treatment of the St. Louis Water Supply," and originally appeared in the Jour. of Assn. of Eng. Soc., Vol. VIII., pp. 477-92.

Tenth Census U. S., Vol. XVII., Water Supply of American Cities, pp. 142-152.

SEDALIA, *Pettis Co.* (Pop. 9,561; est., 22,500.) On high rolling prairie. Engaged in manufacturing. Settled in '69; incorp. city in '64. Has sewers and electric lights.

History.—Built in '71 by city; sold in '87 to Sedalia Water-Works Co., who immediately rebuilt works. Engr. for latter work, J. B. Quigley, who owns one-half of stock. Contrs., Inter-State Gas & Water-Works Co. All of St. Louis.

WORKS PRIOR TO '87.

General Description.—Water was pumped from Spring creek directly to mains and to tank by a gang of 6 upright 12-in. Holly pumps, with two rotary Holly pumps for fire protection. *Dam:* built across creek in '72; 160 ft. long, forming 60,000,000-gall. storage reservoir. *Tank:* at highest part of city, 153 ft. above pumps; 40 x 20 ft., on 40-ft. trestle.

PRESENT WORKS.

Water Supply.—Flat river and Spring creek, pumping to stand-pipes.

Pumping Machinery.—Dy. cap., 9,500,000 galls.; 1,500,000 Holly, Deane and Blake. *Boilers:* steel.

Filter.—Hyatt.

Stand-Pipes.—Cap., 320,000 galls.; two 15 x 125 ft.; from Shickle, Harrison & Howard Iron Co., St. Louis.

Distribution.—*Mains*, c. i., 25 miles. *Services*, galv. i., lead. Pipe and specials from Shickle, Harrison & Howard Iron Co. and South St. Louis Foundry Co. *Taps*, 696. *Meters*, 63. *Hydrants*, Mathews, 150. *Valves*, Chapman.

Consumption, 500,000 galls. *Pressure*, 60 lbs.

Financial.—(In '87.) Cost, $400,000. Cap. stock, $200,000. Bonded debt, $200,000. Int., 6%. Ann. op. exp., withheld, est., $10,000. Ann. rev.: consumers, withheld, est., $25,000; city, $9,300. Hydrant rental, $60.

Management.—Prest. J. B. Quigley. V. Prest. and Treas., Theo. Platt. Secy., A. Schenck. Supt., S. F. Rosse.

SPRINGFIELD, *Greene Co.* (Pop., 6,522; est., 30,000.) Springfield and North Springfield were consolidated in '87. Has electric lights.

History.—Built in '83 by Springfield Water Co., under 20-years franchise. Engr., P. B. Perkins, Springfield. Labor done by Co. Works sold, July 1, '89, to Springfield Water-Works Co.

Water Supply.—Falbright spring, pumping to reservoir, tank and direct.

Pumping Machinery.—Dy. cap., 4,500,000 galls.; Deane dup., comp., cond., added in '89. A 2,000,000 Smith & Vaile was put in in '83. *Boilers:* 100-H. P. added in '89

Force Main.—Of 18-in. c. i., extending 17,000 ft. from pumping station to reservoir and tank: laid in '89.

Reservoir.—Cap., 4,000,000 galls.; 256 x 322 ft. x 14 ft. deep, in earth embankment lined with brick; 53 ft. above and 3¼ miles from city.

Tank.—Cap., 65,000 galls.: 60 ft. above reservoir, and 113 ft. above city.

Distribution.—(In '87.) *Mains*, c. i., 30 miles. *Services*, w. i., lead. *Taps*, about 1,200. *Meters*, 6. *Hydrants*, kind not given (in '89), 155.

Consumption (in '87), 1,000,000 galls. *Pressure:* Ordinary, 50 lbs. Fire, 80 lbs.

Financial.—(In '87.) Cost, $375,107. Cap. stock, $300,000. Debt, $246,000: $200,000 6% bonds, and $46,000 floating debt at 8%. Ann. op. exp., $9,200. Ann. rev.: consumers, $20,900; city, $11,000. Hydrant rental, 76 at $60, and 79 at $50.

Management.—Prest., Geo. P. Wescott. Secy. and Treas., Geo. F. West. Both of Portland, Me. Mgr., W. C. Hornbeak. Supt., D. H. Robertson.

TRENTON, *Grundy Co.* (Pop., 3,312; est., 5,500.) On Grand river. No sewers or electric lights.

History.—Built in '86 by Trenton Water Co. Engr. and Contr., A. H. McCormick, Parsons, Kan.

Water Supply.—Grand river and well close by, filtered, pumping to stand-pipe and direct.

Filter.—Dy. cap., 325,000 galls.; built in Jan. '90.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; Worthington. *Boilers:* from Fairbanks & Co., St Louis.

Stand-Pipe.—Cap., 170,000 galls.; 15 ft. x 130 ft.; from Shickle, Harrison & Howard Iron Co., St. Louis, Mo.

Distribution.—*Mains*, 10 to 4-in c. i., 5½ miles. *Services*, not given. Pipe and specials from Shickle, Harrison & Howard Iron Co.; trenching and pipe laying done by G. C. M Davison, Pittsburgh, Kan. *Taps*, 270. *Meters*, Crown, Worthington, 20. *Hydrants*, White, 50. *Valves*, Peet.

Consumption, 200,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 130 lbs.

Financial.—Cost, $74,000. (Reported $92,000 in last MANUAL.) Cap. stock, $75,000. Debt, $80,000. Int., 6%. Ann. op. exp., $2,500. Ann. rev.: consumers, $5,000; city, $2,000. Hydrant rental, $40.

Management.—Prest., W. H. Taylor, N. Y. City. V.-Prest. and Supt., W. A. Fritts. Report by A. H. McCormick.

WASHINGTON, *Franklin Co.* (Pop., 2,421; est., 6,000.) On Missouri river. Incorp. Has sewers. No electric lights.

History.—Built in '88-9 by Washington Water & Light Co., under 20-years franchise, which is owned by Inter-State Gas & Water-Works Co., St. Louis. Engr., L. P. Andrews, St. Louis.

Water Supply.—Missouri river, pumping to filter and clear water reservoir, thence by repumping to stand-pipe and direct.

Pumping Machinery.—Dy. cap., 2,500,000 galls.; two 1,250,000 Buffalo comp., dup. Pumps and boilers from Pond Engineering Co., St. Louis.

Filter.—Dy. cap., 200,000 galls.; Hyatt; built in Nov., '88.

Settling and Clear Water Reservoirs.—Cap., 400,000 galls. *Settling Reservoir:* cap., 250,000 galls.; rectangular, 10 ft. deep. Embankment 4 ft. wide on top, of yellow clay. Inner slope, nearly 2 to 1, paved with layer of brick flat and layer of brick edgewise, laid in cem. and plastered with 1 in. of Portland cem. *Clear Water Reservoir:* cap., 150,000 galls.; oval. Is constructed like settling basin, but is 25 ft. lower, which allows of filtering by gravity from one to the other. Both reservoirs have concrete floors, and report for '88 states that they are separated by masonry wall, 40 ft. long, 12 ft. high, 5 ft. thick at bottom, 2 ft. thick at top. Engr., see History.

Stand-Pipe.—Cap., 100,000 galls.; 12 x 125 ft.; from M. M. Leckie, Joplin, Mo.

Distribution.—*Mains*, 10 to 4-in. c. i., 5 miles. *Services*, lead, iron. Pipe and specials from Ripley & Bronson, St. Louis; trenching and pipe-laying done by Jno. Maxwell, Kansas City. *Taps*, 22. *Meters*, Worthington, 5. *Hydrants*, Holly-Gaskill, 50. *Valves*, Holly.

Consumption, 65,000 galls. *Pressure*, from stand-pipe, 60 to 90 lbs.

Financial.—Cost, $60,000. Cap. stock, authorized, $80,000. Bonded debt, $50,000. Int., 6%. Hydrant rental, $60.

Management.—Local company not organized. Of Inter-State Gas and Water-Works Co.: Prest., Theo. Plate; V. Prest., L. P. Andrews; Secy., A. Schenck; Supt., E. E. Gilpin.

WEBB CITY and CARTERVILLE, *Jasper Co.* (Pop., Webb City, est., 5,000. Carterville, 483; est., 3,500.) About one mile apart and 6 from Joplin. In lead and zinc mining district. No sewers or electric lights.

History.—Built in '90 by Co., under 20-years franchise; were to be in operation May 1, '90. Des. Engrs., Nier, Hartford & Mitchell, Kansas City. Contr., E. Sutphin, St. Louis.

Water Supply.—Centre creek, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two 1,000,000 Hall comp., dup., with independent condensers. *Boiler:* from J. Mathews, So. Bend, Ind.

Stand Pipe.—Cap., 105,000 galls.; 12x125 ft.; steel,

Distribution.—*Mains*, c. i., 14 miles; from Shickle, Harrison & Howard Iron Co., St. Louis. *Hydrants*, White, 90.|*Valves*, Scott.

Financial.—Cost, $75,000. Cap. stock, $75,000. Bonded debt, $75,000. Int., 6%. Hydrant rental, $60.

Management.—Prest., Jas. O'Neil. Report, Feb. 7, '90.

Water-Works Projected with Fair Prospects of Construction.

BRUNSWICK, *Chariton Co.* (Pop., 1,801; est., 2,500.) On Missouri, a mouth of Grand river. Engaged in manufacturing and river commerce.

Proposed Works.—Brunswick Water-Works Co. to build. Nothing definite settled April 3, '90. Supply, artesian well and Grand river. Prest. and Mgr., L. Bruecke.

BUTLER, *Bates Co.* (Pop., 2,162; est., 3,030.) Has coal deposits. Electric lights projected for '90.

Proposed Works.—Franchise granted to H. S. Dewey, Jefferson City, for works to be completed July 1, '90. Construction had not been begun Feb. 8, '90. Supply, Miami river, pumping to stand-pipe. Est. cost, $60,000. Address, H. S. Dewey, Jefferson City, or P. B. Hickman, Mayor.

MONROE CITY, *Monroe Co.* (Pop., 640; est., 2,000.) Has manufactories.

Proposed Works.—Under consideration. Not decided whether village or Co would build. Supply, surface water gathered in reservoir covering 20 acres, pumping to stand-pipe. Est. cost, $10,000. Address Geo. W. Tompkins, or Sam. J. Nelson. Report, April 3, '90.

NEOSHO, *Newton Co.* (Pop., 1,631; est., 2,500.) Incorp. city of fourth class.

Proposed Works.—A 20-years franchise has been granted to W. P. Munroe, Nevada, but he has not submitted plans. City Clerk, N. A. Morford. Report, about Mar. 10, '90.

Water-Works Projects Reported in '89 and '90, but Now Indefinite.

Lamar, Barton Co.; see MANUAL for '88, p. 474. *Lebanon*, Laclede Co. *Marceline*, Linn Co. *Warrensburgh*, Johnson Co.

ARKANSAS.

Water-Works Completed or in Process of Construction.

ALEXANDER, *Pulaski Co.* (Pop.,est., 200.) Incorp. No sewers or electric lights.

History.—Built in '88 by Alexander Water Co., principally for benefit of stockholders.

Water Supply.—Springs, 50 to 75 ft. above town, by gravity to tank.

Tank.—Cap., about 8,000 galls.

Distribution.—*Mains*, 1¼-in. iron, 1,440 ft. *Taps*, 15. *Meters*, none.

Financial.—Cost, $250. Cap. stock, $300. No debt. No op. exp. Ann. rev.: consumers, $10.

Management.—Prest., Esten Peloubet. Secy. and Treas., A. B. Holland. Supt., E. Koch.

ARKANSAS CITY, *Desha Co.* (Pop., 503; est., 2,000.) On Mississippi river. Incorp. town. No sewers or electric lights.

History.—Built in '89 by Arkansas City Water Co. No Engr.

Water Supply.—Mississippi river, pumping to tank.

Pumping Machinery.—Dy. cap., 500,000 galls.; Hughes.

Tank.—Cap., 70,000 galls.; from Joshua Seamons.

Distribution.—*Mains*, 6-in., 2 miles. *Services*, ¾ to 2-in. *Taps*, 75. *Meters*, none. *Hydrants*, 12.

Financial.—Cost, $8,000. Cap. stock, authorized and paid up, $10,000. No bonds or debt. Ann. op. exp., est., $1,800. Ann. rev.: consumers, est., $2,500; city, $420. Hydrant rental, $35.

Management.—Prest., J. M. Whitehill. Secy., Sam'l Marks. Treas., W. M. Ogburn. Supt., C. C. De Sancha. Report, Mar. 8, '90.

BRINKLEY, *Monroe Co.* (Pop., 325; est., 2,500.) Has car works, oil mills and stave factory.

General Description.—Built by Brinkley Car Works & Mfg. Co., date not given. Furnishes water to town. Supply, deep-well, pumping to 75,000-gall. tank. *Mains*, 2,000 to 3,000 ft. Prest., O. M. Norman. Secy., and Treas., H. H. Myers. Report, about Feb. 10, '90.

CAMDEN, *Ouachita Co.* (Pop., 1,503; est., 3,000.) On Ouachita river. Incorp. city of second class. Sewers projected for '90. Has electric lights.

History.—Built in '89 by Camden Water-Works Co. Engr., Thos. V. Hall. Contrs., J. Walker Bates & Co., N. Y. City.

Water Supply.—Ouachita river, pumping to stand-pipe.

Pumping Machinery.—Dy. cap. (July 1, '89,) 1,500,000 galls.; make not given.

Stand-Pipe.—Cap., 99,000 galls.; 15 x 75 ft.; built in '89.

Distribution.—(July 1, '89.) *Mains*, c. i., 2¼ miles. *Taps*, 125. *Meters*, none *Hydrants*, 10.

Consumption, about 175,000 galls. *Pressure*, not given.

Financial.—Cost, $17,500. Cap. stock, $16,000; authorized, $30,000. Ann. op. exp., est., $2,500. Ann. rev., consumers, $3,000; city, $750.

Management.—Prest. and Supt., S. Q. Sevier. Secy. and Treas., T. J. Ganghan

FORT SMITH, *Sebastian Co.* (Pop., 3,095; est., 20,000.) On Arkansas river on undulating ground. Has large cotton compress and cotton-seed mills. Founded in '38. Incorp. city. Has sewers and electric lights.

History.—Built in '84 by Fort Smith Water Co., under 20-years' franchise from Oct. '87. Des. Engr., Chas. McRitchie, Chicago, Ill.

Water Supply.—Poteau river, filtered, pumping to reservoir. River is mountain stream.

Filter.—Sand and gravel, 20 ft. sq., built around inlet pipe leading to pump-well.

Pumping Machinery.—Dy. cap., 5,500,000 galls.; Smith & Vaile. *Boilers:* 3, with total of 255 H. P.

Reservoir.—Cap., 6,000,000 galls.; 110 ft. above city level.

Distribution.—*Mains*, c. i., 16 miles. *Services*, lead, iron. *Taps*, 860. *Meters*, 8. *Hydrants*, Chapman, 72. *Valves*, Chapman.

Consumption, 500,000 galls. *Pressure:* Ordinary, 50 lbs. Fire, 85 lbs.

Financial.—Cost, $230,000. Cap. stock, $200,000. Bonded debt, $125,000. Int., 6%. Ann. op. exp., $5,005. Ann. rev.: consumers, $15,000; city, $4,000. Hydrant rental, $60 for 50, $50 for additional.

Management.—Prest., Jno. Vaile. Secy., H. Stone. Treas., G. N. Pogue. Supt., E. A. Thomas.

HOPE, *Hempstead Co.* (Pop., 1,233; est., 2,200.) Has some manufactories and electric lights.

History.—Built in '85 by town, under direction of Council.

Water Supply.—Artesian well, 1,100 ft. deep, pumping to tank.

Pumping Machinery.—Dy. cap., not given; Knowles, upright.

Tank.—Cap., 60,000 galls.; 22x22 ft. deep.

Distribution.—(In '87.) *Mains*, w. i., 6 miles. *Services*, w. i. *Taps*, 350. *Meters*, not given. *Hydrants*, kind not given, 6.

Consumption, not given. *Pressure*, 17 lbs.

Financial.—(In '87.) Cost, $15,000. No debt. Ann. op. exp., about $700. Ann. rev.: consumers, not given, est., $1,500.

Management.—(In '88.) Council. Chn., J. R. Jones. Report by D. S. Ferguson.

NOTE.—No report for '89 could be obtained.

HOT SPRINGS, *Garland Co.* (Pop., 3,554; est., 12,000.) On mountain stream in valley between Sugar Loaf and Hot Springs mountains, of Ozark range. Has mining interests. Famous health resort. Settled in '20; incorp. city in '74. Has sewers and electric lights.

History.—Built in '82 by Hot Springs Water Co., under 50-years exclusive franchise. Contr., Carroll E. Gray, Jr., Chicago, Ill.

Water Supply.—Bull bayou and springs, pumping to distributing reservoir. Drainage area of bayou, about ¼ sq. m. of mountain slopes; cap., about 100,000,000 galls.

Dam.—Of masonry, across a narrow gorge in rocks to increase storage capacity of bayou.

Conduit.—Of stone, 5 ft. high and 40 ft. long, leading from dam to pump.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; Worthington dup., comp. at springs, Knowles dup., comp., cond. *Boilers:* return tubular.

Reservoir.—Cap., 1,000,000 galls.; excavated in rock on mountain, 262 ft. above main street of town.

Distribution.—*Mains*, c. i., 9 miles. *Services*, w. i., lead. *Taps*, 275. *Meters*, 67. *Hydrants*, Holyoke, 58. *Valves*, Ludlow.

Consumption, 500,000 galls. *Pressure*, 115 lbs.

Financial.—(In '87.) Cost, $150,000. Cap. stock, $80,000 Bonded debt, $100,000. Int., 6%. Ann. op. exp., withheld, est., $4,500. Ann rev.: consumers, withheld, est., $7,000; city, 5,100. Hydrant rental, $100.

Management.—Prest., A. B. Gaines. Secy., C. W. Fry. Supt., A. N. Sill.

LITTLE ROCK, *Pulaski Co.* (Pop., 13,138; est., 35,000.) On Arkansas river, on rolling ground, the rocky bluff from which city derives its name being 50 ft. high. Settled in '20. Incorp. city. Has sewers and electric lights.

History.—Built in '78 by private Co.; afterward bought by Home Water Co. Arkansas Water Co. put in new pumping plant and reservoir in '87-8 to increase supply and facilities of old, and in '89 whole plant was sold to American Water-Works & Guarantee Co., Ltd., Pittsburgh, Pa., who were to put in filters and otherwise extend works. Franchise runs for 50 years. Contr. for original works, Travers Daniels; for late extensions and improvements, Zeb. Ward.

Water Supply.—Arkansas river, pumping to stand-pipe and to reservoir. Reservoirs were built with new works.

Pumping Machinery.—Dy. cap., 6,000,000 galls.; Blake; 500,000 Worthington high-pressure contracted for in '89. *Boilers:* from Jno. O'Brien Boiler Works Co., St. Louis, Mo.

Stand-Pipe.—Cap., 365,000 galls.; 20 x 100 ft.; on ground 65 ft. above river.

Reservoir.—Cap., 18,000,000 galls.; of stone quarried from reservoir site; in two compartments, one of which serves as settling basin; 150 ft. wide at each end, 180 ft. at partition wall, 600 ft. long; 250 ft. above city. On Nov. 2, '87, but two hours before new works were to be tested, about 60 ft. of division wall gave way, part of contents pouring down the hill; wall was 80 ft. high, 12½ ft. thick at bottom and 6 ft. at the top, laid in cem. mortar and had cem. lining. See Reference, below.

Distribution.—*Mains*, c. i., 19 miles. *Services*, w. i. Pipe and specials from Shickle, Harrison & Howard Iron Co., St. Louis. *Taps* (in '87), 1,044. *Meters*, 33. *Hydrants*, Chapman, 117. *Valves*, Chapman.

Consumption, 2,154,172 galls. *Pressure*, 70 lbs.

Financial.—Cost, $430,000: $180,000 for old works, and $250,000 for new. Cap. stock, $32,500. Bonded debt, $250,000. Int., 6%. Sinking fund, $10,000. Ann. op. exp., $12,000. Ann. rev.: consumers, $25,911; city, $6,672. Hydrant rental, $70.

Management.—(June 26, '89.) Prest., Zeb. Ward. Supt., Secy. and Treas., Zeb. Ward, Jr.

Reference.—"Municipal Improvements of Little Rock." By G. P. C. Rumbough. Trans. Ark. Soc. of Engrs., Archts. and Surveyors, vol. II., pp. 83-93. Besides brief description of water-works, short account of reservoir failure is given, and theory of cause.

NOTE.—Above given before works changed hands.

NEWPORT, *Jackson Co.* (Pop., 683; est., 3,000.) On White river. Engaged in manufacturing. Incorp. No sewers or electric lights.

History.—Built in '86-7 by Newport Irrigation and Water Co. Engr., A. H McCormick, who owns franchise.

Water Supply.—White river, pumping to tank.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; two Smith & Vaile dup. *Boilers:* two horizontal, flue. Contrs., Fairbanks & Co., St. Louis, Mo.

Tank.—Cap., 68,000 galls.; 24x26 ft.; placed on tower 126 ft. high.

Distribution.—*Mains*, c. i., 3¼ miles *Services*, lead, galv. and black i. Trenching and pipe-laying done by G. C. M. Davison, Pittsburgh, Kans. *Taps*, 100. *Meters*, 18. *Hydrants*, Nelson, 53. *Valves*, Peet.

Consumption, 200,000 galls. *Pressure*, Ordinary, 54 lbs. Fire, 54 to 200 lbs.

Financial.—Cost, $52,000. Cap. stock, $100,000. Bonded debt, $40,000. Int., 6%. Ann. op. exp., $800. Ann. rev.: consumers, $1,200; city, $2,570. Hydrant rental, av., $40.

Management.—Prest., A. H. McCormick, Parsons, Kans. Secy., Jos. Staytor. Supt., Wm. Knowles.

PINE BLUFF, *Jackson Co.* (Pop., 3,203; est., 16,000.) On Arkansas river Incorp. city. Has sewers and electric lights.

History.—Built in '88, and now owned by Pine Bluff Water & Light Co. Franchise for 30-years, and was originally granted to, and works were partially built by Water, Light & Power Co., St. Louis, Mo., who turned them over to present owners Co. owns and operates electric lights and gas works, having acquired latter in '88 or 89. Engr. for former Co., F. Wm. Raeder, St. Louis, Mo.; for latter Wm. Barclay Parsons, N. Y. city.

Water Supply.—Cook wells on bank of Arkansas river, pumping direct and to stand-pipe.

Pumping Machinery.—Dy. cap., 3,500,000 galls.; two Buffalo, from Pond Engineering Co., St. Louis, Mo. *Boilers:* two, 80-H. P., from Jno. O'Brien Boiler Works Co., St. Louis, Mo.

Stand-Pipe.—Cap., 85,000 galls.; 10 x 150 ft.; from E. E. Palmer & Sons, Kansas City, Mo.

Distribution.—*Mains*, 14 to 4-in. c. i., 13½ miles. *Services*, galv. i., lead. Pipe and specials from Shickle, Harrison & Howard and South Shore Foundry; trenching and pipe-laying done by H. Diedrich. *Taps*, 400. *Meters*, Crown, number not given. *Hydrants*, Chapman, 179. *Valves*, Eddy.

Consumption, not given. *Pressure:* Ordinary, 60 lbs. Fire, 140 lbs.

Financial.—Cost, $250,000, including electric lights and gas works. Cap. stock, $300,000. Bonded debt, $125,000. Int., 6%. Ann. op. exp., $20,000. Ann. rev.: consumers, $38,000, including that from electric lights and gas; city, $12,000. Hydrant rental, $43.

Management.—Prest., J. F. Thompson. Secy., N. J. Thompson. Both of Elmira N. Y. Supt., D. K. Torrey.

ROGERS, *Benton Co.* (Pop. est., 2,500.) Engaged in manufacture. Incorp. No sewers or electric lights.

History.—Built in '83 by Rogers Lime & Water Co. Engr. and Contr., P. B. Perkins, Springfield, Mo.

Water Supply.—Spring, pumping to tank. Spring has dy. cap. of 876,330 galls., and is 2,600 ft. east of town.

Tank.—Cap., 45,000 galls.; 22 x 16 ft.; 175 ft. above spring; on brick tower, 23½ ft. in diam. at base, and 21½ ft. at top, 45 ft. high, with walls 3 ft. at bottom and 16 ins. at top. Tank rests on c. i. plate placed on 16 wooden beams, each 6 x 12 ins., radiating from pine column 12 ins. sq., braced to masonry.

Pumping Machinery.—Dy. cap., 720,000 galls.; dup., 12 and 7 ins. in diam. and 12-in. stroke; from Hughes, Cleveland, O. *Boiler:* locomotive, 60-H. P.; from Oil City (Pa.) Boiler Works.

Distribution.—*Mains*, 8 to 4-in. c. i., 3 miles. *Taps*, about 100. *Meters*, none. *Hydrants*, kind not given, 8. *Valves*, Perkins & Rumsey.

Consumption, 60,000 galls. *Pressure*, not given.

Financial.—Cost, $13,000. Cap. stock, $12,000. Debt, about $2,000. Int., not given. Ann. op. exp., $1,200. Ann. rev.: consumers, $2,400; city, $300.

Management.—Prest., J. A. C. Blackburn. Secy. and Treas., B. F. Dyer. Supt., J. R. Bredin.

Reference.—"Water Supply of Rogers." By Prof. Jay M. Whitham. Trans. Ark. Soc. of Engrs., Archts. and Surveyors, Vol. II., pp. 94-107.

TEXARKANA, *Miller Co.* (Pop., 3,223; est., 10,000.) Engaged in manufacturing and lumbering. Incorp. Sewers projected in '89. Has electric lights.

History.—Built in '87 by Texarkana Water Co., under 30-years franchise. Const. Engr., Louis Metesser, New Orleans, La. Labor done by Co. and local Contrs.

Water Supply.—Ten flowing Wagner wells, 40 ft. deep, by pumping. Report does not state whether reservoir is for receiving or distributing purposes. Report stated that 10 more Wagner wells were to be put in in '89.

Reservoir.—Cap., 3,000,000 galls.

Pumping Machinery.—Dy. cap., 2,500,000 galls.; Gordon & Maxwell. *Boilers:* Heine safety.

Distribution.—*Mains*, c. i., 7 miles. *Services*, w. i., lead. *Taps*, 194. *Meters*, 5. *Hydrants*, Chapman, 30. *Valves*, Chapman.

Consumption, 1,000,000 galls. *Pressure:* Ordinary, 80 lbs. Fire, 130 lbs.

Financial.—Cost $76,000. Cap. stock, $60,000. Bonded debt, $60,000. Int., 6%. Ann. op. exp., $4,000. Ann. rev.: consumers, $11,500; city $2,525. Hydrant rental, $100 for 20, $75 for 7.

Management.—Prest., J. A. Polhomius. Secy., F. M. Polhomius. Supt., E. N. Maxwell.

NOTE.—A paper on these works was read by A. B. Watson, at second annual meeting of Ark. Soc. of Engrs., Architects and Surveyors, at Little Rock, Nov. 22-4, '88.

Water-Works Projected with Fair Prospects of Construction.

BATESVILLE, *Independence Co.* (Pop., 1,264; est., 3,000.) On White river. Has manganese mines. Incorp., town.

Proposed Works.—Batesville Water Co. sinking artesian well, from which it is hoped water will be pumped to reservoir. Hydrant contract, $40 each. Prest., I. N. Reid. Treas., Simon Adler. Report, Feb. 8, '90.

BEEBE, *White Co.* (Pop., 428; est., 2,000.)

Proposed Works.—Beebe Artesian Well Co. sinking well. Contr., Eugene Witt, Beebe. If flow is obtained distribution may be put in. Prest., F. P. Lane. Report, Feb. 8, '90.

HELENA, *Phillips Co.* (Pop., est., 5,000.) On Mississippi river. Engaged in manufacturing. Has electric lights.

Proposed Works.—Projected as early as '88; see MANUAL for '88, p. 477. Unofficially reported, Nov. '89, that Helena Gas, Power & Water Co. had been organized with cap. of $10,000. Prest., Nick Straub. Secy., Wm. Neal. Treas., L. Lucy. Also unofficially reported, Apr., '90, that above Co. had contracted with Carlos Well Co., Memphis, Tenn., to sink two 1,000-ft. 8-in. wells.

MAMMOTH SPRING, *Fulton Co.* (Pop., 291; est., 800.) Incorp. city. To have electric lights.

Proposed Works.—Mammoth Spring Water, Light & Motor Co. to build. Supply, Mammoth spring, by gravity. Spring said to have dy. flow of 400,000,000 galls. Est. cost, $20,000. Sept. 9, '89, it was not known when construction would be begun, but before close of year contract was let for 700,000-gall. Worthington pump. Prest., Robt. Greer. Secy., E. F. Brock.

MONTICELLO, *Drew Co.* (Pop., 891; est., 1,600.) Has saw and grist mills.

Proposed Works.—Borchardt Water Co. began construction Dec., '89, but it was not known when works would be completed. Supply, artesian well, pumping to stand-pipe. Report by E. Borchardt; date, Jan. 9, '90.

STUTTGART, *Arkansas Co.* (Pop., est., 2,000.)

Proposed Works.—Stuttgart Improvement Co. to build in '90. Supply, driven wells, pumping to tank for domestic use, to reservoir for fire protection. Est. cost, $15,000. Prest., F. M. Gillett. Secy., E. D. Hall. Treas., C. K. Leslie. Report, Apr. 12, '90.

Water-Works Projects Reported in '89 and '90, but now Indefinite.

Arkadelphia, Clarke Co. *Eureka Springs*, Carroll Co. *Jonesborough*, Craighead Co. *Lonoke*, Lonoke Co.; see MANUAL for '88, p. 477. *Russellville*, Pope Co. *Wynne*, Cross Co.

TEXAS.

Water-Works Completed or in Process of Construction.

ABILENE, *Taylor Co.* (Pop., est., 3,500.) Has some manufactories.

History.—Built in '85-6 by private Co., and bought by town in '87. Des. Engr., ——— Groscup. Contrs., Groscup & Keith.

Water Supply.—Wells and Lytle creek, pumping to stand-pipe or direct.

Pumping Machinery.—Dy. cap., 720,000 galls.; two 360,000 Blake dup. *Boilers:* two, 3½x14-ft., tubular. All from Pond Engineering Co., St. Louis, Mo.

Stand-Pipe.—Cap., 70,000 galls.; 12x85 ft. Contr., ——— Hamilton, Galveston.

Distribution.—(In '87.) *Mains*, c. i., 4 miles. *Services*, w. i. Pipe and specials from Shickle, Harrison & Howard Iron Co., St. Louis, Mo. *Taps*, 85. *Meters*, none. *Hydrants*, kind not given, 35.

Consumption (in '87), 60,000 galls. *Pressure*, 65 lbs.

Financial.—(In '87.) Cost, $42,500. Debt, $32,500. Int., 8%. Ann. op. exp., $2,400. Ann. rev.: consumers, not given, est., $2,500.

Management.—Council. Pumpg. Engr., D. M Carter.

AUSTIN, *Travis Co.* (Pop., 10,960; est., 27,000.) On Colorado River, about 650 ft. above the sea. Engaged in manufacturing. Incorp. city. Has two miles of private sewers and electric lights.

History.—Built in '75 by private Co. after plans by W. R. Freeman. Rebuilt in '82 with M. C. Orton as Des. Engr. In '87, Austin Water, Light & Power Co. was organized, and they now own works.

Water Supply.—Colorado river, by direct pumping.

Pumping Machinery.—Dy. cap., 6,000,000 galls.; 500,000 Gaskill horizontal; make of other pumps not given. In '84, 3,000,000 Holly quadruplex, and 2,000,000 gall. Worthington dup. were used.

Distribution.—*Mains*, c. i., 40 miles. *Services*, not given. *Taps*, 1,603. *Meters*, kind not given, 382. *Hydrants*, kind not given, 142.

Consumption, 2,000,000 galls *Pressure:* Ordinary, 55 lbs. Fire, 140 lbs.

Financial —(In '83.) Cost, $350,000. Cap. stock, $350,000. Bonded debt, $310,000. Int., 7%. Ann. op. exp., not given; est., $10,000. Ann. rev.: consumers, $36,500. Hydrant rental $100 for 100, $50 for additional.

Management.—Prest. M. D. Mather. Secy., D. L. Wickes. Supt., R. H. Felter.

BEAUMONT, *Jefferson Co.* (Pop., est., 3,500.) On Neches river. Engaged in manufacturing. Incorp. Partially sewered. Has electric lights.

History.—Built in '88 by city; leased in '89 for 30 years to Beaumont Ice, Light and Refrigerating Co. Engrs. and Contrs., Thomas & Gorman, Houston, Tex.

Water Supply.—Neches river, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; one 750,000 Smith & Vaile. *Boilers:* return tubular.

Stand-Pipe.—Cap., 102,000 galls.; 12 x 120 ft.

Distribution.—*Mains*, c. i., 3 miles. *Services*, not given. *Taps*, not given. *Meters*, none. *Hydrants*, kind not given, 42.

Consumption, 700,000 galls. *Pressure*, not given.

Financial.—Cost, $20,000. Bonded debt, $10,000; running 30 years. Int., 6%. Ann. op. exp., about $400. Ann. rev.: consumers, $1,500; city, none. Hydrant rental, city has free use of 42 hydrants, but rent must be paid on all put in after '89.

Management.—Prest., L. P Ogden. Secy. and Supt., E. L. Bacon. Treas., V. Wiess.

BELTON, *Bell Co.* (Pop., 1,797; est., 5,000.) On Leon river. Has manufactories. Settled in '44; incorp. town. Partially sewered. Has electric lights.

History.—Built in '84 by town, and now leased and operated by Belton Light and Water Co. Engr., M. L. Lynch, Galveston. Contrs., W. C. Connor, Dallas.

Water Supply.—Leon river, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; two Worthington.

Stand-Pipe.—Cap., 200,000 galls.; 20 x 86 ft.; plate-iron; on hill 123 ft. above pumps, 80 ft. above public square, midway between and about one mile from each.

Distribution.—*Mains*, c. i., 6 miles. *Services*, w. i. *Taps*, 450. *Meters*, 1. *Hydrants*, kind not given, 28.

Consumption, 300,000 galls. *Pressure:* Ordinary, 70 lbs. Fire, 140 lbs.

Financial.—Cost, $45,000. Bonded debt, $40,000. Int., 6%. Ann. op. exp., $3,500. Ann. rev.: consumers, $5,500; city, none.

Management.—Prest., B. D. Lee. Secy., Chas. B. Smith. Treas., D. A. Chamberlin. Supt., N. K. Smith.

BRENHAM *Washington Co.* (Pop., 4,101; est., 7,500.) Incorp. No sewers or electric lights.

History.—Built in '85 by private Co. under 25-years franchise.

Water Supply.—Springs, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Deane, comp., dup. *Boiler:* from Wiggan & Simpson.

Stand-Pipe.—Cap., 110,000 galls.; 14 x 100 ft.

Distribution.—*Mains*, c. i., 5½ miles. *Services*, w. i., galv. i. *Taps*, 200. *Meters*, 3. *Hydrants*, from Wiggan & Simpson, 35.

Consumption, 125,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—Cost, $6,800. Debt, $60,000. Int., 6%. Ann. op. exp., $2,000. Ann. rev.: consumers, $5,000; city, $1,750. Hydrant rental, $50.

Management.—Prest., F. A. Engelke. Secy., J. N. Brown. Treas., D. C. Giddings. Supt. and Pumpg. Engr., J. H. Ledlie.

BROWNWOOD, *Brown Co.* (Pop., 725; est., 3,500.) Incorp. No sewers or electric lights.

History.—Built in '86-7 by town. Des. Engr., M. L. Lynch, Galveston. Contrs., R. D. Wood & Co., Philadelphia, Pa.

Water Supply.—Natural reservoir in bed of Pecan bayou, two miles from court house, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 2,400,000 galls.: two Worthington, comp., dup. *Boilers:* two, 40-H. P., steel, tubular.

Stand-Pipe.—Cap., 220,000 galls.; 20 x 100 ft.; from Contrs.

Distribution.—*Mains*, 10 to 4-in. c. i., 5¼ miles; laid by Thomas & Storrie, Dallas. *Services*, not given. *Taps*, 190. *Meters*, none. *Hydrants*, Mathews, 46. *Valves*, Eddy.

Consumption, 50,000 galls. *Pressure:* Ordinary, 46 lbs. Fire, 120 lbs.

Financial.—Cost, $48,000. Debt, $46,000: $20,000 at 8, $26,000 at 6%. Sinking fund, $1,560. Ann. op. exp., $1,560 Ann. rev.: consumers, $3,200.

Management.—Council. Secy., Ed. Smith. Supt., Brooke Smith.

BRYAN, *Brazos Co.* (Pop., est., 4,500.) Near Brazos river. Incorp. city. No sewers. Electric lights projected.

History.—Built in '89-90 by Bryan Water, Ice & Electric Light Co., under 25-years franchise; was to be in operation Apr. 1. Engr. and Contr., L. F. Fuller, Calvert.

Water Supply.—Wells, pumping to stand-pipe; from Ripley & Bronson, St. Louis, Mo.

Pumping Machinery.—Dy. cap., 750,000 galls.; two Smith & Vaile. *Boilers:* Atlas.

Stand-Pipe.—Cap., 84,600 galls.

Distribution.—*Mains*, 8 to 4-in. c. i., 4 miles. *Hydrants*, 16. *Valves*, Scott.

Pressure: Ordinary, 40 lbs. Fire, 150 lbs.

Financial.—Cost, $25,000. Cap. stock, authorized, $50,000; paid up, $15,000. Bonds authorized and sold, $18,000. Hydrant rental, $103.12 for 16, $75 for additional.

Management.—Prest., J. N. Henderson. Secy., A. D. McCounico. Treas., J. P. Borough. Supt., T. N. Carey. Report, Feb. 10, '90.

CALVERT, *Robertson Co.* (Pop., 2,280; est., 3,500.) Engaged in manufacturing. Incorp. No sewers or electric lights.

History.—Built in '86-7 by Calvert Water, Ice and Electric Light Co., under 25-years franchise. Des. Engr., T. M. Jones. Const. Engr., L. T. Fuller. Contrs., Gorman & Renckie, Dallas, Tex.

Water Supply.—Artesian well, pumping to stand-pipe and reservoir.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; one 750,000 Smith & Vaile and one Knowles. *Boilers:* Atlas.

Stand-Pipe.—Cap., 85,000 galls.; 12 x 100 ft.; from Ripley & Bronson, St. Louis, Mo.

Reservoir.—Cap., 35,000 galls.; brick and cem.

Distribution.—*Mains*, c. i., 5¼ miles; from Ripley & Bronson, St. Louis, Mo *Taps*, 145. *Meters*, Worthington, Hersey, 30. *Hydrants*, Chapman, 11.

Consumption, 50,000 galls. *Pressure:* Ordinary, 45 lbs. Fire, 150 lbs.

Financial.—Cost, $17,500. Cap. stock, authorized, $25,000; paid in, $8,250. Bonded debt, $7,500. Int., 8%. Sinking fund, $225. Ann. op. exp., $1,000. Ann. rev.: consumers, est., $2,300; city, $825. Hydrant rental, $75.

Management.—Prest. and Supt., L. T. Fuller. Secy. and Treas., J. A. Foster.

CASTROVILLE, *Medina Co.* (Pop., 731; est., 1,000.

History.—Built in '87 or '88 by J. Conover, who was Des. Engr.

Water Supply.—Stream, pumping to tank.

Pumping Machinery.—Dy. cap., 50,000 galls.; rotary pump, make not given.

Tank.—Cap., 10,000 galls.

Distribution.—*Mains*, w. i.

Financial.—Cost, $3,000. No debt.

Management.—Owner, T. M. Conover.

CLEBURNE, *Johnson Co.* (Pop. 1,855; est., 8,000.) On high, rolling prairie, between Brazos and Trinity rivers. Incorp. No sewers. Has electric lights.

History.—Built in '83-4 by town. Des. Engr., D. C. Heron. Contr., W. Brown.

Water Supply.—Springs, pumping to tank and direct. Vitrified drain-pipe collects water from several springs and conducts it to pump-well.

Pump-Well.—Is 26 ft. in diam. and depth, walled in and covered with brick in cem.

Pumping Machinery.—Dy. cap., 1,250,000 galls.; two Worthington, one comp., dup., of 16-in. steam and 10¼-in. water cylinders, and other of 16 and 10-in. steam and 8½-in. water cylinders, all of 10-in. stroke.

Tank.—Cap., about 60,000 galls.; 20 x 25 ft.; on brick tower 51½ ft. high, with walls 2 ft. thick, bottom of tank resting on rolled iron beams.

Distribution.—*Mains*, kal. i., 8 miles. *Services*, not given. *Taps*, 232 *Meters*, none. *Hydrants*, kind not given, 40.

Consumption, 120,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 200 lbs.

Financial.—Cost, $56,000. No debt. Ann. op. exp., $1,600. Ann. rev.: consumers, $3,100.

Management.—City Council. Supt., G. Whittenberg.

COLORADO, *Mitchell Co.* (Pop., est., 2,000.) On Colorado river. Manufactures salt. Incorp. No sewers or electric lights.

History.—Built in '85 by town, and leased and operated by Caldwell & Fletcher. Engr., J. M. Bassett, Weatherford. Labor done by city and local Contrs.

Water Supply.—Wells, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 350,000 galls.; Knowles.

Stand-Pipe.—Cap., 285,000 galls.; 22x100 ft.

Distribution.—*Mains*, c. i., 7 miles. *Services*, w. i. Pipe and specials from L. M. Rumsey & Co., St. Louis, Mo. *Taps*, 300. *Meters*, 32. *Hydrants*, kind not given, 16.

Consumption, 40,000 galls. *Pressure:* Ordinary, 75 lbs. Fire, 80 lbs.

Financial.—Cost, $56,000. Debt, $56,000, of which $53,000 is bonds. Int., 6%. Ann. op. exp., $1,000. Ann. rev.: consumers, $2,500; city, $800. Hydrant rental, $16 to $60.

Management.—Council. Lessees, Caldwell & Fletcher.

COLUMBUS, *Colorado Co.* (Pop., 1,959; est., 3,000.) On Colorado river. Incorp. No sewers or electric lights.

History.—Built in '84 by town. Des. Engr., G. C. Stevens. Const. Engr. and Contr., J. T. Jones.

Water Supply.—Colorado river, pumping to tank and direct.

Pumping Machinery.—Dy. cap., 350,000 galls.; Blake dup. of 12-in. steam and 7-in. water cylinders of 12-in. stroke.

Tank.—Cap., 52,000 galls.; 20x22 ft.; iron, on 60-ft. brick tower, having walls 2½ ft. thick at base with slight batter; 110 ft. above pump; from King Iron Bridge Co., Cleveland, O. Wooden tank was formerly used.

Distribution.—*Mains*, 6 and 4-in. c. i., 3 miles. *Services*, w. i. *Taps*, 80. *Meters*, none. *Hydrants*, Bailey, 9. *Valves*, Chapman.

Consumption, 15,000 galls. *Pressure:* Ordinary, 35 lbs. Fire, 100 lbs.

Financial.—Cost, $30,000. Bonded debt, $25,000. Int., 8%. Ann. op. exp., $700. Ann. rev.: consumers, $850.

Management.—Supt., T. Hahn. Pumpg. Engr., Jacob J. Dick.

CORSICANA, *Navarro Co.* (Pop., 3,373; est., 10,000.) On rolling prairie land. Incorp. Has sewers and electric lights.

History.—Built in '84 by Corsicana Water Co., under 25-years franchise. Des. Engr., G. C. Heron.

Water Supply.—Lake, pumping to stand-pipe. Lake has area of 115 acres.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two 1,000,000 Worthington. *Boilers:* Atlas.

Stand-Pipe.—Cap., 235,000 galls.; 20x100 ft.; on hill 45 ft. above surrounding land.

Distribution.—*Mains*, kal. i., 7 miles. *Services*, galv. i. *Taps*, 400. *Meters*, none. *Hydrants*, Ludlow, 61. *Valves*, Ludlow.

Consumption, 500,000 galls. *Pressure:* Ordinary, 55 lbs. Fire, 150 lbs.

Financial.—Cost, $250,000. Cap. stock, $75,000. Bonded debt, $130,000; $80,000 at first and $50,000 at second issue. Int., 7%. Ann. op. exp., $4,000. Ann. rev.: consumers, $10,000; city, $5,300. Hydrant rental, $85.

Management.—Prest., Sam'l. R. Frost. Secy., and Treas., Bryan T. Barry. Supt., Chas. Seevir.

CUERO, *De Witt Co.* (Pop., 1,333; est., 3,500.) Incorp. city. No sewers or electric lights.

History.—Built in '89-90 by city; was to be in operation spring of '90. Engr., W. R. Freeman, San Antonio. Contr., Guido Jaeger, Rich Hill, Mo.

Water Supply.—Guadalupe river, pumping direct and to stand-pipe.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; two 500,000 comp., dup.

Stand-Pipe.—Cap., 157,000 galls.; 16 x 105 ft.

Distribution.—*Mains*, c. i., 6 miles. *Services*, lead, w. i. *Hydrants*, 35.

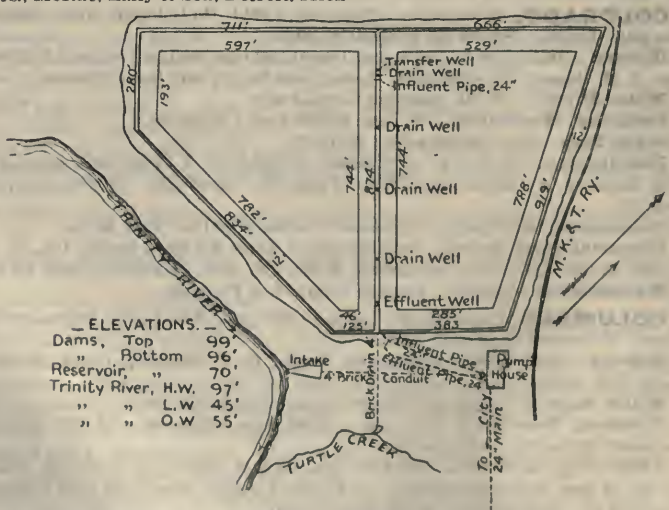
Pressure: Ordinary, 50 lbs. Fire, 150 lbs.

Financial.—Cost, $35,000. Bonded debt, $30,000. Int., 8%.

Management.—City Council. Report, Nov. 25, '89.

DALLAS, *Dallas Co.* (Pop., 10,358; est., 45,000.) On Trinity river, just below mouth of Elm fork, on bluff 25 to 30 ft. above high water. Settled in '41; incorp. town in '44. Has sewers and electric lights.

History.—Built in '76 by city after plans by Travers Daniels, and rebuilt in '84 by Chester B. Davis, Chicago, Ill. In '88 large reservoirs were built, and other improvements made. Des. Engr., J. D. Cook, Toledo, O. Const. Engr., R. W. Harris. Contrs., McRae, Lally & Son, Detroit, Mich.



Plan of Turtle Creek Reservoir, Dallas, Tex.

Water Supply.—Trinity river and springs, pumping to reservoir and stand-pipe. Originally water was pumped to stand-pipe from well 32 x 80 ft., sunk in coarse gravel, and connected with river by 500 ft. of 12-in. iron pipe.

Pumping Machinery.—Dy. cap., 4,500,000 galls.; Worthington and Gaskill horizontal. Two small Knowles were used until they became insufficient. *Boilers:* from J. Wanzler, St. Louis, Mo.

Turtle Creek Reservoirs.—Cap., 140,000,000 galls.; area, 20 acres; depth, 25 ft.; 99 ft. above river; in two basins, which serve both settling and storage purposes. In excavation and clay embankments, without heart-wall; outer part of embank-

ment contains some black earth; banks, 29 ft. high, 2 to 27 ft. being above natural surface; 12 ft. wide at top. Inner slope, 2 to 1, paved with 4 ins. brick, set on edge in cem., on 3-in. gravel bed. See accompanying plan. Under construction in '89. Des. Engr. and Contrs., see History. Const. Engr., N. Werenskiold, Dallas. Cost, about $204,000.

Stand-Pipe.—Cap., 150,000 galls.; 15 x 116 ft.; from Thomas & Storrie, Dallas.

Distribution.—(Apr. 15, '89.) *Mains*, 18 to 4-in., c. i., 25.3 miles. *Services*, w. i. Pipe and specials, lately, from Shickle, Harrison & Howard Iron Co., St. Louis, Mo. *Taps*, 1,764. *Meters*, none. *Hydrants*, Ludlow, Chapman, Mathews, 177.

Consumption, 2,548,132 galls. *Pressure*, 50 lbs.

Financial.—(Apr. 15, '89.) Cost, $350,000. Bonded debt, $295,000: $195,000 at 6, $100,000 at 5%. Ann. op. exp., $29,327. Ann. rev.: consumers, $44,956.

Management.—Chn. Com., L. S. Garrison. Supt., D. Tichenor.

DECATUR, *Wise Co.* (Pop., 579; est., 3,000.)

General Description.—Built in '83 by A. R. Whitehead, and enlarged in '89. A 72,000-gall. Cook deep-well pump lifts water to 36,000-gall. tank. In '89 a 1,000,000 Smith & Vaile was added. *Mains*, 3-in., extending throughout village.

NOTE.—No report for '89 could be obtained.

DEL RIO, *Val Verde Co.* (Pop., est., 1,800.) Not incorp. No sewers or electric lights.

History.—Built in '83 by S. P. R. R. Co. Engr., M. J. Converse, San Antonio. Co. contemplate putting in a turbine wheel and stand-pipe.

Water Supply.—Springs, pumping to tank.

Pumping Machinery.—Dy. cap., not given; Deane.

Tank.—Cap., 10,000 galls.

Distribution.—*Mains*, 4 and 2-in. c. i., 10 miles. *Services*, not given. *Taps*, 150. *Meters*, none. *Hydrants*, kind not given, 30.

Consumption, 75,000 galls. *Pressure:* Ordinary, 65 lbs. Fire, 160 lbs.

Financial.—Cost, withheld, est., $150,000. Debt, withheld. Ann. op. exp. $3,500. Ann. rev.: consumers, $2,600; city, not given, est., $1,000. Hydrant rental, $35.

Management.—C. C. Gibbs, Houston, Texas. Secy., Geo. W. Polk. Supt., P. Flate.

DENISON, *Grayson Co.* (Pop., 3,975; est., 15,000.) Incorp. No sewers. Has electric lights.

History.—Built in '86-7 by Denison City Water Co., under 20 years franchise. Engr., E. F. Fuller. Contrs., Saml. R. Pullock's Co. Both of N. Y. City.

Water Supply.—Wells and surface water, latter impounded in reservoir, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two 1,500,000 Gaskill horizontal, comp., cond.

Stand-Pipe.—Cap., 160,000 galls.; 15 x 125 ft.; from Shickle, Harrison & Howard Iron Co., St. Louis, Mo.

Distribution.—(In '87.) *Mains*, c. i., 12 miles. *Services*, w. i., lead. Pipe and specials from Shickle, Harrison & Howard Iron Co. *Taps*, 375. *Meters*, 38. *Hydrants*, Holly, 75.

Consumption, not given. *Pressure:* Ordinary, 75 lbs. Fire, 150 lbs.

Financial.—Cost, $400,000. Cap. stock, $200,000. Bonded debt, $200,000. Int., 6%. Ann. op. exp. (in '87), $4,100. Ann. rev.: consumers (in '87), $8,120; city $7,500. Hydrant rental, $100.

Management.—Prest., H. S. Hopper. Secy. and Treas., W. Wood. Supt., M. G. Fitzgerald.

EAGLE PASS, *Maverick Co.* (Pop., est., 2,500.) On Rio Grande river. Incorp. city. No sewers. Has electric lights.

History.—Built in '84 by Eagle Pass Water Supply Co., under 40-years franchise. Supplies water for domestic use only. Des. Engr., W. R. Freeman, San Antonio. Co. to build works in '90 in neigboring city of Porfino Diaz, Mexico. New plant will be complete, give fire protection, and will be connected with present, by main laid across wagon bridge, so that either can supplement the other.

Water Supply.—Rio Grande river, filtered, pumping to reservoir.

Filter.—Gravel and sand; location not given.

Pumping Machinery.—Dy. cap., not given; Worthington.

Reservoir.—Cap., 2,000,000 galls.

Distribution.—*Mains*, c. i., 5¼ miles. *Services*, w. i. *Taps*, withheld, est., 200. *Consumption*, 1,000,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 65 lbs.

Financial.—Cost, $32,000. Cap. stock, authorized and paid up, $20,000. No debt on this plant; $20,000 bonds issued for Porfino Diaz works, but not sold, time of report. Ann. op. exp., withheld, est., $3,000. Ann. rev.: total, withheld, est., $6,000.

Management.—Prest., F. H. Hartz. Secy., M. Hartz. Treas., Ed. Schmidt. Report, Feb. 11, '90.

EAST DALLAS, *Dallas Co.* (Pop., est., 4,000.)

History.—Built in '86 by East Dallas Water Supply Co., under 50-years franchise.

Water Supply.—Well, pumping to stand-pipe. Well is 36 ft. in diam. x 25 ft. deep.

Pumping Machinery.—Dy. cap., 500,000 galls.; Deane.

Stand-Pipe.—Cap., 110,000 galls.; 14 x 100 ft.

Distribution.—(In '87.) *Mains*, c. i., 3½ miles. *Services*, galv. i. *Taps*, 110. *Meters*, 3. *Hydrants*, Chapman, 15. *Valves*, Chapman.

Consumption, 200,000 galls. *Pressure*, 40 lbs.

Financial.—(In '87.) Cost, $30,000. Bonded debt, $30,000. Int., 7%. Ann. op. exp., $1,200. Ann. rev.: consumers, $3,000; city, $450. Hydrant rental, $30; to be increased.

Management.—(In '88.) Prest. and Supt., T. J. Oliver. Secy., T. L. Morsalis.

NOTE.—No report for '89 could be obtained.

EL PASO, *El Paso Co.* (Pop., 736; est., 10,600.) On Rio Grande river in dry sandy valley. Settled in '27; incorp. village in '53, city in '78. Has sewers and electric lights.

History.—Built in '82 by El Paso Water Co., under 25-years franchise. Engr. and Contr., Sylvester Watts, St. Louis, Mo. These works supply Ft. Bliss, a Government post 1½ miles distant.

Water Supply.—Rio Grande river, pumping to reservoirs.

Dam.—Built to divert water into ditches for irrigating purposes. Size and character not given.

Pumping Machinery.—Dy. cap., 3,500,000 galls.; 1,175,000 Gordon & Maxwell, and 1,750,000 Smith & Vaile. *Boilers:* four tubular.

Reservoirs.—Cap., 6,000,000 galls.; 3, serving for settling and distributing purposes, their elevation above city being from 200 to 180 ft.

Distribution.—*Mains*, w. i., kal. i., 10 miles. *Services*, w. i. Pipe and specials from Chattanooga (Tenn.) Foundry & Pipe Works. *Taps*, 800. *Meters*, 450. *Hydrants*, White, 44. *Valves*, Ludlow.

Consumption, 600,000 galls. *Pressure*, 74 lbs.

Financial.—Cost, $120,000. Cap. stock, $20,000. Bonded debt, $80,000, Int., 6% Ann. op. exp., $15,000. Ann. rev.: consumers, $24,000; city, $3,000. Hydrant rental $100 for 25, $60 and $40 for additional.

Management.—Prest., J. W. Parker. Secy., H. Lawton. Supt., W. H. Watts.

FORT WORTH, *Tarrant Co.* (Pop., 6,663; est., 30,000.) At junction of Trinity and Clear Fork rivers on rolling prairie land. Incorp. city. Has sewers and electric lights.

History.—Built in '82-3 by private Co., and now owned by city. Engr., M. C. Orton. Contrs., Drake & Orton, N. Y. City. Later work has been done with H. McLoughlin as Des. Engr.

Water Supply.—Trinity river, Clear creek and gang wells, by direct pumping. Gang well system was adopted in '88, Mr. F. O. Brown contracting to put down 95 2-in. wells, 24 ft. deep, in gravel bed under river. These are about 9 ft. apart, on each side of and 3 ft. from main suction pipe. There is receiving or settling well. A detailed description of wells is given in *Engineering News*, vol. XVIII., p. 396. Formerly water was taken from river, through two wells, 20 ft. sq. and 16 ft. deep, sunk in its gravel bed.

Pumping Machinery.—Dy. cap., 4,000,000 galls.; 3,000,000 Holly quadruplex and 1,000,000 Worthington. A 2,000,000 Worthington, comp., cond. was contracted for in latter part of '89.

Distribution.—*Mains*, c. i., 21 miles. *Services*, w. i. *Taps*, 1,500. *Meters*, 30. *Hydrants*, Holly, 128. *Valves*, Ludlow.

Consumption, 3,000,000 galls. *Pressure:* Ordinary, 85 lbs. Fire, 120 lbs.

Financial.—Cost, $320,000. Bonded debt, $200,000. Int., 7%. Ann. op. exp., $24,000. Ann. rev.: consumers, $36,000; city, $11,800. Hydrant rental, $100 for 100, $50 for additional.

Management.—Chn. Com., Geo. Nies. City Clerk, R. W. Armentout. Supt., A. W. Scoble.

GAINESVILLE, *Cook Co.* (Pop., 2,667; est., 10,000.) Has electric lights.

History.—Built in '83-4 by Gainesville Water Co., under 50-years franchise.

Water Supply.—Elm river, by direct pumping.

Reservoir.—Cap., 115,000,000 galls. [Probably formed by dam across river.]

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Gaskill horizontal.

Distribution.—(In '87.) *Mains*, c. i., 8.4 miles. *Services*, w. i. *Taps*, 400. *Meters*, 103. *Hydrants*, Ludlow, 84. *Valves*, Ludlow.

Consumption, 500,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 120 lbs.

Financial.—(In '87.) Cost, $183,000. Cap. stock, $200,000. Bonded debt, $160,000. Int., 6%. Ann. op. exp., $5,850. Ann. rev.: consumers, $7,062; city, $6,400. Hydrant rental, $100 for 100, $50 for additional.

Management.—(In '88.) Prest., J. S. Drake. Secy., H. B. Fletcher. Supt., Wm. L. Pierce.

NOTE.—No report for '89 could be obtained.

GALVESTON, *Galveston Co.* (Pop., 22,248; est., 40,000.) On island at mouth of Galveston bay. Incorp. city. No sewers. Has electric lights.

GALVESTON WATER CO.'S WORKS.

General Description.—Built in '84, taking supply from artesian wells, by pumping through c. i. pipe. No further information can be obtained.

CITY'S WORKS.

History.—Built in '88-9; put in operation June 1. Engr., J. D. Cook, Toledo, O. Supt. of Const., Jno. A. Cotter.

Water Supply.—Thirteen artesian wells, pumping to stand-pipe and storage tank. Wells are 800 ft. apart, on Winnie St.; have dy. cap. of 2,000,000 galls. Contr. L. Siegel, N. Y. City.

Pumping Machinery.—Dy. cap., 8,000,000 galls.; two 3,000,000 Knowles comp., cond., and one 2,000,000 Worthington. *Boilers:* four 5¼ x 16-ft. return tubular; from Union Iron Works, Chattanooga, Tenn.

Tank.—Cap., 1,177,500 galls.; iron or steel; 100 x 20 ft.; cost, $21,200.

Stand-Pipe.—Cap., 485,000 galls.; 25 x 150 ft.; from Riter & Conley, Pittsburgh, Pa.; cost, $43,200.

Distribution.—*Mains*, c. i., 32 miles. *Services*, not given. Pipe and specials from R. D. Wood & Co., Philadelphia, Pa.; trenching and pipe-laying done by H. Merigold, Lima, O. *Taps*, 50. Meters, none. *Hydrants*, Mathews, 350. *Valves*, Eddy. *Valve-boxes*, Bingham & Taylor, Buffalo, N. Y.

Consumption, 1,000,000 galls. *Pressure*, not given.

Financial.—Cost, $450,000. Int., 5%. Op. exp. and rev. not determined.

Management.—Five Comrs. Prest., A. Weis. Secy., Danl. J. Buckley. Supt., Jno. A. Cotter.

GEORGETOWN, *Williamson Co.* (Pop., 1,354; est., 3,500.) On San Gabriel river. Incorp. No sewers or electric lights.

History.—Built in '84 by city, and leased by San Gabriel Water-Works Co. Des. Engr., G. C. Heron. Const. Engr., M. P. Kelley. Contrs., East Texas Water & Gas Co.

Water Supply.—San Gabriel river, pumping to stand-pipe and direct.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Worthington.

Stand-Pipe.—Cap., 230,000 galls.; 20x100 ft.; from Riter & Conley, Pittsburgh, Pa.

Distribution.—*Mains*, kal. i., 6½ miles. *Services*, w. i. Pipe and specials from L. E. Rumsey Mfg. Co. *Taps*, 250. *Meters*, kind not given, 5. *Hydrants*, Ludlow, 21. *Valves*, Ludlow.

Consumption, 350,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 120 lbs.

Financial.—Cost (in '87), $51,000. Cap. stock, $15,000. Bonded debt, $14,000. Int., 6%. Ann. sinking fund, 2%. Ann. op. exp., $1,200. Ann. rev.: consumers, $4,500; city, none.

Management.—Prest., E. Taylor. Secy. and Supt., W. J. Thomas. Treas., L. M. Taylor.

GONZALES, *Gonzales Co.* (Pop., 1,581.; est., 2,500.) On Guadalupe river in rolling country. Settled prior to '25; incorp. town under Republic of Texas. No sewers or electric lights.

History.—Built in '84 by Gonzales Water-Works Co. Engr., T. S. Walker, Gonzales

Water Supply.—Guadalupe river, pumping to stand-pipe, tank and direct.

Intake.—Is 3 ft. in diam., 120 ft. long; brick, laid in cem.

Pumping Machinery.—Dy. cap., 280,000 galls.; Worthington. *Boilers:* two, return tubular.

Stand-Pipe.—Cap., 80,000 galls.; 12 x by 100 ft.; built in '88.

Tanks.—Cap., 40,000 galls.; two of cypress 51 ft. above city.

Distribution.—*Mains*, kal. i., 6 miles. *Services*, galv. i. *Taps*, 220. *Meters*, none *Hydrants*, Ludlow, 14. *Valves*, Ludlow.

Consumption, 90,000 galls. *Pressure:* Ordinary, 30 lbs. Fire, 120 lbs.

Financial.—Cost, $20,000. Cap. stock, $12,000. Debt, $2,500. Int., 10 and 12%. Ann. op. exp.; $1,200. Ann. rev.: consumers. $3,600; city and county, $150.

Management.—Prest., C. Braches. Secy., R. H. Walker. Treas., J. M. Walker. Supt., T. S. Walker.

GREENVILLE, *Hunt Co.* (Pop., est., 7,000.) Incorp. Has sewers and electric lights.

History.—Built in '88-9 by Greenville Water & Electric Light Co.; put in operation, June 1, '89. Des. Engr., Chas. H. Ledlie. Consult. Engr. Thos. J. Whitman. Res. Engr., W. W. Primm. All of St. Louis, Mo. Contrs., Laing & Co., Dallas, Tex.

Water Supply.—Cowleach fork of Sabine river, pumping from reservoir, through filter, to stand-pipe.

Pumping Machinery.—Dy. cap., 2,500,000 galls.; two Volker & Felthousen or Buffalo comp., cond., plunger.

Dam and Reservoir.—Cap., 310,000,000 galls. Dam, of masonry, forming reservoir. No further data.

Filter.—Dy. cap., 700,000 galls.; American.

Stand-Pipe.—Cap., 165,210 galls.; from Shickle Harrison & Howard Iron Co., St. Louis, Mo.

Distribution.—*Mains*, 15 to 6-in. c. i., 5.2 miles. *Services*, not given. *Taps*, 53. *Meters*, 7. *Hydrants*, Ludlow, 60. *Valves*, Ludlow.

Consumption, about 50,000 galls. *Pressure* 60 lbs.

Financial.—Cost, $123,000. Cap. stock, $100,000, No debt. Ann. op. exp., est., $3,500. Ann. rev.: consumers, $6,000; city, $5,000. Hydrant rental, $83.

Management.—Prest., J. M. Cook. Secy. and Treas., F. B. Nichols, St. Louis, Mo. Supt., W. C. Irwin.

HOUSTON, *Harris Co.* (Pop., 16,513; est, 34,000.) On Buffalo bayou, an arm of Galveston bay, 50 miles from Galveston, on undulating land. Settled in '30. Incorp. No sewers. Has electric lights.

History.—Built in '78-9 by Houston Water-Works Co. Contrs., Inman Bros., N. Y. City.

Water Supply.—Flowing artesian wells, pumping to stand-pipe and direct. Dy. flow, 1,750,000 galls. Last well sunk, at time of report, was 312 ft. deep, and had dy. yield of 400,000 galls.; additional well, 8 ins in diam., being bored. Supply formerly from Buffalo bayou.

Storage Tank.—Cap., 235,000 galls.; 20 x 100 ft.; built in '89. Wells are to discharge into tank, which was not completed at time of report.

Pumping Machinery.—Dy. cap., 8,000,000 galls.; one 5,000,000 and one 3,000,000 Worthington. First pump used was Worthington dup., of 12-in bore. *Boilers:* Heine safety.

Stand-Pipe.—Cap., about 790,000 galls.; 30 x 150 ft. Plate iron stand-pipe, 20 x 88 ft., was formerly used.

Distribution.—*Mains*, c. i., 29 miles. *Services*, galv. i. *Taps*, 1,100. *Meters*, 22. *Hydrants*, Ludlow, 198. *Valves*, Ludlow.

Consumption, 2,000,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 90 lbs.

Financial.—Cost, $325,000. Cap. stock, $150,000. Bonded debt, $150,000. Int., 6%. Ann. op. exp., withheld, est., $15,000. Ann. rev.: consumers, withheld, est., $40,000; city, $9,250. Hydrant rental, $50.

Management.—Prest., T. H. Scanlan. V. Prest. and Treas., T. W. House. Secy., J. E. Knight. Supt., C. H. Sprong.

KERRVILLE, *Kerr Co.* (Pop., 156; est., 1,200.) On Guadalupe river. Has roller flour mills. Incorp. town.

General Description.—Under construction, March, '90, by Chas. Schreiner.

KYLE, *Hays Co.* ((Pop., est., 1,000.) Incorp. No sewers or electric lights.

History.—Built in '87-8 by Kyle Water Co.

Water Supply.—Rio Blanco river, pumping to tanks.

Pumping Machinery.—Dy. cap., 100,000 galls.; Deane.

Tanks.—Cap., 63,000 galls.; two.

Distribution.—*Mains*, w. i., 7½ miles. *Services*, not given. *Taps*, 18. *Meters*, none. *Hydrants*, kind not given, 10.

Consumption, 25,000 galls. *Pressure*, 48 lbs.

Financial.—Cost, $11,800. Debt, $8,000. Int., 8%. Ann. op. exp., $600. Ann. rev.: consumers, $1,000; city, $240.

Management.—Prest., H. Hellman. Secy., C. L. Sledge. Supt., J. J. Hay.

LAMPASAS, *Lampasas Co.* (Pop., 653; est., 3,400.) On Sulphur fork of Lampasas river. Incorp. No sewers or electric lights.

History.—Built in '85 by town. Contrs., Brown & Connor, Dallas. Contract was first let to B. Van Sternberg, who failed to finish works.

Water Supply.—Sulphur creek, pumping to stand-pipe and direct.

Pumping Machinery.—Dy. cap., 1,250,000 galls.; Worthington. *Boilers:* tubular.

Stand-Pipe.—Cap., 115,000 galls.; 20 x 50 ft.

Distribution.—*Mains*, c. i., 6½ miles. *Services*, w. i. *Taps*, 132. *Meters*, kind not given, 2. *Hydrants*, Ludlow, 25. *Valves*, Ludlow.

Consumption, 50,000 galls. *Pressure:* Ordinary, 40 to 50 lbs. Fire, 100 to 120 lbs.

Financial.—Cost, $45,000. Bonded debt, $40,000. Int., 7%. Ann. op. exp., $2,000 Ann. rev.: consumers, $3,000.

Management.—Com. of 3. Chf. Engr., H. K. Hedeman.

LAREDO, *Webb Co.* (Pop., 3,521; est., 8,500.) On Rio Grande river in hilly country. Settled in 1794; incorp. village in '48. No sewers. Has electric lights.

History.—Built in '83-4 by Laredo Water Co., under 30-years franchise, city having privilege of buying works. Engr. and Contr., W. D. Richardson, Springfield, Ill.

Water Supply.—Rio Grande river, filtered, by direct pumping. A 10-in. pipe originally conducted water to settling and pump well.

Filter Wells.—On island in river. No description given.

Pumping Machinery.—Dy cap., 3,000,000 galls.; two Blake comp., dup. A 1,500,000 Worthington comp., cond., added in '89. *Boilers:* two, 50-H.-P.

Distribution.—*Mains*, kal. i., 10 miles. *Services*, galv. i. Pipe and specials from National Tube Works Co., McKeesport, Pa. *Taps*, 410. *Meters*, none. *Hydrants*, Ludlow, 100. *Valves*, Ludlow.

Consumption, 600,000 galls. *Pressure:* Ordinary, 45 lbs. Fire, 125 to 150 lbs.

Financial.—Cost, $120,000. Cap. stock, $50,000. Bonded debt, $90,000. Int., 8%. Ann. op. exp., $6,000. Ann. rev.: consumers, $14,000; city, $7,500. Hydrant rental, $75 for first 100, $60 for additional.

Management.—Prest., A. L. McLane. Secy., R. Martin. Supt., A. Magnon.

LLANO, *Llano Co.* (Pop., est., 1,000.) On Llano river. No sewers or electric lights.

History.—Built in '86 by W. W. Knowles & Son. May 20, '89, owners stated they proposed to enlarge works.

Water Supply.—Llano river, pumping to tank.

Pumping Machinery.—Dy. cap., 25,000 galls.; water-power.

Tank.—Cap., 17,000 galls.

Distribution.—*Mains*, w. i. 2½ miles. *Services*, w. i. *Taps*, 60. *Meters*, 1. *Hydrants*, none.

Consumption, 15,000 galls. *Pressure*, 40 lbs.

Financial.—Cost, $4,000. No debt. Ann. op. exp., $25. Ann. rev.: consumers, $600; city, $18.

Management.—W. W. Knowles & Son.

LOCKHART, *Caldwell Co.* (Pop., 1,500.)

History.—Built in '87 by Lockhart Water Supply Co. Des. Engr., D. T. Cahill. Const. Engr., Jno. Clark.

Water Supply.—Well, pumping to tank.

Pumping Machinery.—Dy. cap., 20,000 galls.; driven by windmill till '89, when engine was added.

Tank.—Cap., 10,000 galls.

Distribution.—*Mains*, 4-in., 1 mile. *Services*, not given. *Taps*, 24. *Hydrants*, not given.

Consumption, 5,000 galls. *Pressure*, not given.

Financial.—Cost, $1,000. No debt.

Management.—Supt., A. R. Chew. Report by J. G. Blank.

MARSHALL, *Harrison Co.* (Pop., 5,624; est., 8,500.) Engaged in manufac turing. Incorp. No sewers. Has electric lights.

History.—Built in '88-9 by city, put in operation April 1, '89. Des. Engr., Jno. W. Nier, now of Nier & Mitchell, Kansas City, Mo. Const. Engr., and Contr., E. Sutphin, Sherman, Tex.

Water Supply.—Twenty-four Wagner steamed wells, pumping to stand-pipe and direct.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; two 500,000 Deane.

Stand-Pipe.—Cap., 165,000 galls.; 15 x 125 ft.

Distribution.—*Mains*, c. i., 9 miles. *Services*, not given. *Taps*, 104. *Meters*, none. *Hydrants*, kind not given, 50.

Consumption, est., 1,500,000 galls. *Pressure*, 50 to 200 lbs.

Financial.—(June 15, '89.) Cost, $67,000. Debt, $67,000. Int., 6%. Op. exp. and rev., not determined.

Management.—Supt., A. F. McAllister.

MEXIA, *Limestone Co.* (Pop., 1,298; est., 3,500.) Has flouring, planing and saw mills. Incorp. No sewers or electric lights.

History.—Built in '87-8 by Mexia Water, Ice and Light Co. Engr., John R. Corley. Improvements were projected in '89 for '90.

Water Supply.—Artificial lake, pumping to stand-pipe and direct.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Smith & Vaile. *Boiler:* built in '90, not described.

Stand-Pipe.—Cap., 86,000 galls.

Distribution.—*Mains*, 6-in. c. i., 5 miles. *Services*, not given. *Taps*, 100. *Meters*, none. *Hydrants*, kind not given, 15.

Consumption, 30,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 60 to 80 lbs.

Financial.—Cost, $30,000. Cap. stock, $30,000. Bonded debt, $18,500; 40-years. Int., 6%. Ann. sinking fund, $370. Ann. op. exp., $1,500. Ann. rev.: consumers, $2,300; city, $1,500. Hydrant rental, $100.

Management.—Prest., D. M. Prendergast. Secy. and Supt., Jno. R. Corley.

MORGAN, *Bosque Co.* (Pop., est., 700.) Not incorp. No sewers or electric lights.

History.—Built in '89 by J. Muirhead, who acted as Engr.; put in operation Dec. 27, '89. For domestic supply only.

Water Supply.—Flowing artesian well, by gravity to tank. Well is 680 ft. deep, and is kept closed by 4½-in. valve, except when filling tank.

Tank.—Cap., 8,640 galls.; 72½ ft. above ground.

Distribution.—*Mains*, 2½ ins., down, 1½ miles. *Taps*, 34. No hydrants.

Pressure, 20 lbs.

Financial.—Cost, $7,000. No debt.

Management.—Owner, J. Muirhead.

NAVASOTA, *Grimes Co.* (Pop., 1,611; est., 4,000.) On Brazos river, at month of Navasota river. Incorp. No sewers or electric lights.

History.—Built in '86-8 by city, and leased for 25 years to E. L. Bridges, who was Contr Engr., J. T. Jones.

Water Supply.—Artesian well, pumping to stand-pipe and tank.

Pumping Machinery.—Dy. cap., 900,000 galls.; one 800,000 Smith & Vaile high-pressure, and one 100,000 Deane, deep-well.

Stand-Pipe.—Cap., 58,800 galls.; 10 x 100 ft.

Tank.—No data.

Distribution.—*Mains*, 8 to 2-in., material not given, 4½ miles. *Services*, not given. *Taps*, 110. *Meters*, 3. *Hydrants*, Chapman, 12.

Consumption, 60,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 160 lbs.

Financial.—Cost, $20,500. Bonded debt, $15,000; 50-years. Int., 8 and 6%. Sinking fund, $3,000. Ann. op. exp., $2,000. Ann. rev.: consumers, $2,700; city, $1,200. Hydrant rental, $100.

Management.—E. L. Bridges, Lessee. Secy., E. Norwood. Supt., Edward Haven.

NEW BRAUNFELS, *Comal Co.* (Pop., 1,938; est., 2,000.) On Guadalupe river. Has some manufactories. Incorp. No sewers or electric lights.

History.—Built in '86 by town. Des. Engr., W. W. Freeman, San Antonio. Const. Engr. and Contr., G. Gerlich, New Braunfels.

Water Supply.—Comal river, pumping to reservoir and direct.

Pumping Machinery.—Dy. cap., 900,000 galls.; Knowles.

Reservoir.—Cap., 350,000 galls.

Distribution.—*Mains*, c. i. 4 miles. *Services*, w. i. Pipe and specials from Dennis Long & Co., St. Louis, Mo. *Taps*, 140. *Meters*, none. *Hydrants*, kind not given, 28. *Valves*, Ludlow.

Consumption, 200,000 galls. *Pressure:* Ordinary, 24 lbs. Fire, 120 lbs.

Financial.—Cost, $21,000. Bonded debt, $13,000. Int., 6%. Ann. op. exp., $1,500. Ann. rev.: consumers, $1,440; city, $2,500.

Management.—Supt., C. Ulzes. Report by Gustav Gerlich.

PALESTINE, *Anderson Co.* (Pop., 2,997; est., 5,000.) On ridge six miles from Trinity river. Settled in '30. Incorp. No sewers. Has electric lights.

History.—Built in '81-2 by Palestine Water Co., under 30-years franchise. Engr., J. T. Jones. Contr., Carroll E. Gray, Jr., Chicago, Ill.

Water Supply.—Springs, pumping from receiving reservoir to stand-pipe and direct.

Nearly 100 springs in two valleys, ½ and 1 mile long, respectively, furnish supply. Springs issue from outcrop of of stratum of fine white sand which underlies from 8 to 10 ft. of clay, along base of hills. Each spring is enclosed with wooden curbs, lined with brick in cem. and covered with trap doors. Their flow is collected by 3 to 12 in. earthenware pipes.

Receiving Reservoir.—Is 65 ft. in diam., 30 ft. deep; has tight brick walls.

Pumping Machinery.—Dy. cap., 500,000 galls.; two pumps, designed by Wm. E. Worthen.

Stand-Pipe.—Is 2 x 125 ft.; 3,500 ft. from, and on ground which is 90 ft. above pumps, and 35 ft. above town; plate iron; supported by 8 wire rope guys, with turn buckles, 4 attached 80 ft. above bottom and 4 at top of pipe.

Distribution.—*Mains*, c. i., 7 miles. *Services*, w. i. *Taps*, 210. *Meters*, 11. *Hydrants*, kind not given, 10 public and 15 private.

Consumption, 240,000 galls. *Pressure:* Ordinary, 30 lbs. Fire, 65 lbs.

Financial.—Cost, about $130,000. Bonded debt, $80,000. Int., 6%. Ann. op. exp., $5,500. Ann. rev.: consumers, $9,500; city, $1,705. Hydrant rental, $100.

Management.—Prest., M. L. Gray. Treas., Dwight Tredway. Supt., T. M. W. Glashan.

NOTE.—Above same as in '88 MANUAL, Co. reporting "no change."

PANHANDLE CITY, *Carson Co.* (Pop., est., 350.)

General Description.—May 3, '89, contract for artesian well had been let by private Co. to Cook Well Co., St. Louis, Mo. Water for domestic use was to be furnished, previous supply having been hauled on train. Est. cost, $3,000.

PARIS, *Lamar Co.* (Pop., 3,980; est., 12,000.) Ten miles south of Red river. Incorp. No sewers. Has electric lights.

History.—Built in '83 and owned jointly by city and Paris Water Co. Engr., J. D. Thomas. Contrs., M. P. Kelley and E. E. Taylor, Georgetown, Texas.

Water Supply.—Well, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 2,500,000 galls.; make not given.

Stand-Pipe.—No data.

Distribution.—*Mains*, 10 miles. *Taps*, 100. *Meters*, 37. *Hydrants*, 81.

Financial.—Cost, $102,000. Company furnished $20,000 in cash, which constitutes their cap. stock, and city issued $82,000 of bonds. Op. exp. and rev., not determined.

Management.—Prest. of Co., J. D. Thomas.

SAN ANGELO, *Tom Greene Co.* (Pop., 4,000; est., do.) Incorp. No sewers. Has electric lights.

History.—Built in '84 by San Angelo Water-Works Co., under 50-years franchise. Des. Engr., Geo. F. Meyers. Labor done by Co.

Water Supply.—North Concho river, pumping to tank and direct.

Pumping Machinery.—Dy. cap., 500,000 galls.; Deane, comp., dup. *Boilers:* horizontal, tubular.

Tank.—Cap., 60,000 galls.; 24x18 ft.; wooden.

Distribution.—*Mains*, w. i., 4 miles. *Services*, w. i., lead. *Taps*, 133. *Meters*, 6. *Hydrants*, Chapman, Holyoke, 44. *Valves*, Chapman.

Consumption, 60,000 galls. *Pressure:* Ordinary, 50 lbs. Fire, 125 lbs.

Financial.—(In '87.) Cost, $40,000. Cap. stock and bonds, $50,000. Int., not given. Ann. op. exp., $2,600. Ann. rev.: consumers, about $2,600; city (in '88), $2,500; county (in '88), $300. Hydrant rental, $41.63; county, $75.

Management.—Prest. and Mgr., J. L. Millpaugh.

SAN ANTONIO, *Bexar Co.* (Pop., 20,550; est., 45,000.) On San Antonio and San Pedro rivers. Business portion is nearly level, and on each side ground rises gradually to elevation of about 100 ft. Settled by Spaniards in 1714; incorp. city in 73. No sewers. Has electric lights.

History.—Built in '78-9 by San Antonio Water-Works Co., under 50 years franchise. Engr., W. R. Freeman, who, backed by King Bridge Co., Cleveland, O., was also Contr.

Water Supply.—San Antonio springs, pumping to reservoir and direct. Springs are at the head of San Antonio river.

Dam.—Built by Spaniards; riprap, giving head and fall of 9 ft., for driving pumps.

Pumping Machinery.—Dy. cap., 10,250,000 galls.; 4 water-power and one steam Worthington,

Reservoir.—Cap., 5,000,000 galls.; 18 ft. deep and 150 ft. above city; in excavation and embankment, with slopes paved with limestone.

Distribution.—*Mains*, 24 to 4-in. c. i., 75 miles. *Services*, w. i. *Taps*, 3,600. *Meters*, Crown, Worthington, 25. *Hydrants*, Mathews, Chapman, 420. *Valves*, Eddy, Chapman.

Consumption, 2,000,000 galls. *Pressure:* Ordinary, 65 lbs. Fire, 90 lbs.

Financial.—(In '87.) Cost, withheld, est., 700,000. Cap. stock, $680,000. Bonded debt, $680,000: $180,000 at 7, and $500,000 at 6%. Ann. op. exp., $20,000. Ann. rev.: consumers, withheld, est., $120,000; city, $20,500. Hydrant rental, $50.

Management.—Prest., G. W. Brackenridge. V. Prest., F. Herff. Secy. and Supt., J. Ulrich. Treas., San Antonio National Bank.

SAN MARCOS, *Hays Co.* (Pop., 1,232; est., 2,500.) On San Marcos river Settled in '20; incorp. town in '76. No sewers. Has electric lights.

History.—Built in '83 by San Marcos Water Co., under 12-years franchise Engr. and Contr., C. M. Holmes, Seguin.

Water Supply.—San Marcos river, pumping to reservoir and direct.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; two Worthington water-power, of 8½-in. cylinder and 10½-in. stroke, and one 1,000,000 Gordon & Maxwell.

Reservoir.—Cap., 230,000 galls.; 60 ft. in diam., 9 ft. deep; walls of stone; 190 ft. above pumps and 162 ft. above town.

Distribution.—*Mains*, c. i., w. i., 7 miles. *Services*, w. i. *Taps*, 350. *Meters*, none. *Hydrants*, from Rusk (Tex.) Penitentiary, 21.

Consumption, 300,000 galls. *Pressure:* Ordinary, 65 lbs. Fire, 90 lbs.

Financial.—Cost, $50,500. Cap. stock, $25,000. Bonded debt, $25,500. Int., 7%. Ann. op. exp., $1,400. Ann. rev.: consumers, $5,000; city and county $1,300. Hydrant rental, $50.

Management.—Prest., W. O. Hutchinson. Secy., D. Hopkins. Treas., D. A. Glover. Supt., R. Pettit.

SEGUIN, *Guadalupe Co.* (Pop., 1,363; est., 2,500.) Incorp. No sewers or electric lights.

History.—Built in '86-7 by Seguin Water & Ice Co., under 20-years franchise. Engr., C. M. Holmes, Seguin. Labor done by Co.

Water Supply.—Guadalupe river, pumping to stand-pipe and direct.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Gordon & Maxwell, water-power and steam.

Stand-Pipe.—Cap., about 60,000 galls.; 10 x 100 ft.

Distribution.—*Mains*, c. i., w. i., 6 miles. *Services*, not given. *Taps*, 150. *Meters*, none. *Hydrants*, Nelson, 15.

Consumption, 50,000 galls. *Pressure:* Ordinary, 45 lbs. Fire, 100 lbs.

Financial.—Cost, $27,000. Cap. stock, $25,000. Bonded debt, $19,000. Int., 7%. Ann. op. exp., $1,250. Ann. rev.: consumers, $3,061; city, $1,050. Hydrant rental, $75.

Management.—Prest., Jas. T. Holmes. Secy., C. M. Holmes. Treas., J. M. Blanks.

SHERMAN, *Grayson Co.* (Pop., 6,093; est., 10,000.) Thirteen miles from Red river. Incorp. city. No sewers. Has electric lights.

History.—Built in '87-8 by city; electric lights operated in connection with water-works. Des. Engr., —— Hayne. Const. Engr., W. C. Connor, Dallas, Texas. Contr., E. Sutphin.

Water Supply.—Gang-wells, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Worthington.

Stand-Pipe.—Cap., 300,000 galls.

Distribution.—*Mains*, 9 miles. *Taps*, 250. *Meters*, Worthington, 30. *Hydrants*: Chapman, 70. *Valves*, Chapman.

Consumption, 100,000 galls. *Pressure*, 60 lbs.

Financial.—Cost, $70,000. Bonded debt, $70,000. Int., 8%. Ann. sinking fund, 2%. Op exp. and rev., not kept separate from electric lights.

Management.—Mayor, J. S. Porter. Secy., B. I. Roe. Supt., Robt. Harvey.

TAYLOR, *Williamson Co.* (Pop., est., 4,000.) Incorp. No sewers or electric lights.

History.—Built in '82-3 by Taylor Water Co., under 50-years franchise. Engr., J. T. Jones. Labor done by Co.

Water Supply.—Springs and San Gabriel river, pumping to tank, stand-pipe and direct.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Blake at river and Worthington in city; from Pond Engineeeing Co., St. Louis, Mo. A 1,000,000 comp. was added in '89.

Tank.—Cap., 93,000 galls. Contrs., Kelley & Tomlinson, then of Taylor.

Stand-Pipe.—Built in '89; 100 ft. high.

Distribution.—*Mains*, c. i., w. i., 8 miles. *Services*, w. i. Pipe and specials from Shickle, Harrison & Howard Iron Co., St. Louis, Mo. *Taps*, 185. *Meters*, kind not given, 2. *Hydrants*, Bailey, 25. *Valves*, Eddy.

Consumption, 200,000 galls. *Pressure:* Ordinary, 57 lbs. Fire, 90 to 125 lbs.

Financial.—(In '87.) Cost, withheld, est., $65,000. Cap. stock, $72,000. No debt or bonds. Ann. op. exp., $2,500. Ann. rev.: consumers, $6,500; city, $1,500. Hydrant rental, $100.

Management.—Prest., G. W. Burkitt. Secy., A. A. Stevens. Both of Palestine. Supt., W. H. Riley.

TEMPLE, *Bell Co.* (Pop., est., 5,000.) Incorp. No sewers or electric lights.

History.—Built in '84 by Temple Water-Works Co., under 50-years franchise. Engr., M. L. Lynch. Labor done by Co.

Water Supply.—Surface wells, pumping to stand-pipe. Supply from Leon river, 6½ miles distant, was contracted for in '89.

Pumping Machinery.—Dy. cap., 720,000 galls.; Worthington. *Boilers:* two, 40-H.P., steel.

Stand-Pipe.—Cap., 55,000 galls.; iron.

Distribution.—*Mains*, c. i., 2½ miles. *Services*, c. i. Pipe and specials from Gloucester Iron Works, Philadelphia, Pa. *Taps*, 150. *Meters*, none. *Hydrants*, kind not given, 12.

Consumption, 50,000 galls. *Pressure:* Ordinary, 52 lbs. Fire, 100 lbs.

Financial.—Cost, $22,000; cost of extensions in course of construction, $60,000. Cap. stock, $15,000. No debt; $50,000 in bonds to be issued to defray cost of extensions. Ann. op. exp., $1,300. Ann. rev.: consumers, $1,750; city, $1,000. Hydrant rental, $80.

Management.—Prest. and Supt., G. E. Wilcox. Secy., O. K. Burwitz. Treas., A. Bentley.

TERRELL, *Kaufman Co.* (Pop., 2,003; est., 4,000.) At head of small valley, on divide between Trinity and Sabine rivers, in undulating country. No sewers. Electric lights projected.

History.—Built in '84 by town. Des. Engr., G. C. Heron. Const. Engr., M. T. Brown. During construction works were sold to M. T. Brown, but they are now owned by city.

Water Supply.—Two wells, pumping to stand-pipe and direct. Wells are 25 ft. in diam. for 27 ft., and then have wells bored 45 ft. deeper.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; two Worthington. *Boilers:* Atlas.

Stand-Pipe.—Cap., about 45,000 galls.; 10 x 75 ft.; on ground 75 ft. above pumps.

Distribution.—*Mains*, kal. i., 3 miles. *Services*, not given. *Taps*, 75. *Meters*, 1. *Hydrants*, kind not given, 32.

Consumption, 100,000 galls. *Pressure*, not given.

Financial.—Cost, $37,200. Bonded debt, $53,000. Int., 7%. Money to pay int. raised by direct tax. Ann. op. exp., $1,900. Ann. rev.: consumers, $1,960; $1,020 from Ry. Co.

Management.—Supt., S. M. Cannon.

TEXARKANA, *Bowie Co.* (Pop., 3,225.) Has electric lights.

General Description.—There is 2,000,000 Worthington, pumping to stand-pipe. *Mains*, 8 miles. *Hydrants*, 50. *Pressure*, 45 lbs. City Clerk, V. E. Burer. Supt., R. J. Heywood.

TEXAS STATE PENITENTIARY, *Huntsville, Walker Co.* (Pop., 600.)

History.—Built in '84 by State.

Water Supply.—Artesian well, 630 ft. deep, pumping to stand-pipe and direct.

Pumping Machinery.—Dy. cap., 50,000 galls.; Worthington.

Stand-Pipe.—Cap., 128,000 galls.; 16 x 85 ft.

Distribution.—*Mains*, 6 and 4-in. c. i., 2,500 ft. *Hydrants*, 16; made by Penitentiary.

Consumption, 40,000 galls. *Pressure:* Ordinary, 40 lbs. Fire. 100 lbs.

Financial.—Cost, $5,000. No debt or rev. Ann. op. exp., $800.

Management.—Foreman Machine Works, C. H. Robinson. Financial Agt., W. G. Parish.

TYLER, *Smith Co.* (Pop., 2,423; est., 7,000.) At headwater of Neches river, in rolling hilly country. Settled in '47; incorp. village in '51, city in '70. No sewers. Has electric lights.

History.—Built in '83 by Tyler Water Co., under 50-years franchise. Works were begun by city, but sold before their completion. Des. Engr., J. A. Jones. Labor done by local Contrs.

Water Supply.—Springs, pumping from impounding reservoir to stand-pipe.

Dam and Reservoir.—Cap., 40,000,000 galls. Dam, of earth, with puddle core 3 ft. thick. Unofficially reported that heavy rain carried dam away before it was finished, necessitating rebuilding.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Worthington duplex, high-pressure.

Stand-Pipe.—Cap., 397,000 galls.; 35 x 55 ft.; 15 ft. added in '88 or '89. Formerly there was plate-iron tank 24 x 22½ ft., on brick tower 24 ft. sq. and 50 ft. high, with walls 3 ft. thick, and foundation walls 7 ft. thick. This tank was 100 ft. above pumps and 119 ft. above business part of city.

Distribution.—*Mains*, 8 to 4-in. c. i., 11 miles. *Services*, w. i. *Taps*, 200. *Meters*, 4. *Hydrants*, kind not given, 100.

Consumption, 400,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 80 to 100 lbs.

Financial.—Cost, $115,000. Cap. stock, $100,000. Bonded debt, $100,000. Int., 7%. Sinking fund, $12,000. Ann. op. exp., $3,000. Ann. rev.: consumers, $10,000; city, $5,000. Hydrant rental, $50.

Management.—Prest., L. B. Fish. Secy. and Supt., B. W. Howland. Treas., H. G. Asken.

VICTORIA, *Victoria Co.* (Pop., 4,000; est., 5,000.) On Guadalupe river. Incorp. No sewers. Electric lights projected.

History.—Built in '85 by city.

Water Supply.—Guadalupe river, pumping to stand-pipe and direct.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; two 500,000 Blake. *Boilers:* two, 35-H. P. All from Pond Engineering Co., St. Louis, Mo.

Stand-Pipe.—Cap., 150,000 galls.; 16 x 100 ft.

Distribution.—*Mains*, c. i., 5 miles. *Services*, galv. i. *Taps*, 186. *Meters*, none. *Hydrants*, Bailey, 48. *Valves*, Eddy.

Consumption, 45,000 galls. *Pressure:* Ordinary, 42 lbs. Fire, 150 lbs.

Financial.—Cost, $18,000. Bonded debt, $45,000. Int., 6%. Sinking fund, $7,950. Ann. op. exp., $1,350. Ann. rev.: consumers, $2,550.

Management.—Com. Supt., Wm. Wheeler.

WACO, *McLennan Co.* (Pop., 7,295; est., 22,000.) On Brazos river, on ground rising to an elevation of 130 ft. in 1½ miles. Settled in '30; incorp. city in '58. Has sewers and electric lights.

WACO WATER AND POWER CO.

History.—Built in '78 and enlarged in '86-7 by Waco Water Co., reorganized Jan. 10, '90, as Waco Water & Power Co. Des. Engr., W. R. Freeman. Const. Engr., C. W. White.

Water Supply.—Wells and Brazos river, pumping to reservoir. Before reservoir was built wooden tanks with cap. of 100,000 galls were used. New Co. will extend mains three miles to Bosque river for additional water supply.

Pumping Machinery.—Dy. cap., 3,500,000 galls.; 1,000,000 Worthington and 2,500,000 Knowles; latter erected in '88.

Reservoir.—Cap., 6,000,000 galls.; 140 ft. above city.

Distribution.—*Mains*, c. i., w. i., 24½ miles. *Services*, w. i. *Taps*, 1,200. *Meters*, 75. *Hydrants*, Mathews, 150. *Valves*, Eddy.

Consumption, 2,000,000 galls. *Pressure*, 60 lbs.

Financial.—Cost, $350,000. Cap. stock, new issue, $500,000; increased from $100,000. Bonded debt, $350,000, issued by new Co.; $300,000 to retire old bonds. Int., 6%. Ann. op. exp., $5,000. Ann. rev.: consumers, $20,500; city, $9,000. Hydrant rental, $75.

Management.—Prest., C. W. White. Secy., H. D. White. Supt., A. J. Douglas.

BELL WATER CO.

History.—Put in operation Sept. 1, '89. Engr., J. D. Bell, Prest. Contrs., R. C. Storrie & Co., Dallas.

Water Supply.—Artesian wells, by gravity to stand-pipe. Dy. flow of wells, 1,500,000 galls.

Stand-Pipe.—Cap., 188,000 galls.; 20 x 80 ft.; from Ripley & Breason, St. Louis Mo.

Distribution.—*Mains*, 16 to 4-in., 25 miles; from Rusk Tix, So. Pittsburgh, Tenn. *Taps*, 1,000. *Meters*, Worthington, number not given. *Hydrants*, 160.

Pressure, 64 lbs.

Financial.—Cost, $200,000. Cap. stock, $200,000. No bonds or debt. Hydrant rental, $40 for 125, $35 for additional.

Management.—Prest., J. D. Bell. Secy., J. T. Davis. Treas., C. H. Higginson. Supt., A. M. Prescott. Report, Dec. 20, '89.

WEATHERFORD, *Parker Co.* (Pop., 2,046; est., 5,000.) Eleven miles from Brazos river. Manufactures castor oil, flour and brooms. Incorp. No sewers. Has electric lights.

History.—Built in '88 by Weatherford Water, Light and Ice Co., under 25-years franchise. Engr., W. R. Freeman, Dallas, Tex.

Water Supply.—Large well with radiating tunnel, by pumping to elevated reservoir, thence by gravity.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; two comp., dup., pumps, make not given. *Boilers:* two, Buckeye tubular.

Reservoir.—Cap., 1,100,000 galls.; 80 ft. square, 14 ft. deep; on top of hill. Embankment of gravel and broken rock, one-half of reservoir being in rock excavation, 15½ ft. high, 27.8 ft. wide at bottom, 9 ft. wide at top. Inner slope and bottom puddled, with 15 ins. of clay well rammed, then paved with rough stone. Inner slope, 1½ to 1. No spillway. *Discharge pipe:* 12-in. Does not leak. Engr., J. M. Barrett. No Contr. Cost, $4,100.

Distribution.—*Mains*, c. i., 3½ miles. From Chattanooga (Tenn.) Foundry & Pipe Co. *Services*, w. i. *Taps*, 42. *Meters*, none. *Hydrants*, Beaumont, 25. *Valves*, Eddy.

Consumption, not determined. *Pressure:* Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—Cost, $65,000. Cap. stock, $50,000. Bonded debt, $50,000. Int., 7%. Ann. op. exp., $4,800. Ann. rev.: consumers, $1,170; city, $1,725. Hydrant rental, $75 for first 15, $60 for additional.

Management.—Prest., W. J. Sherman. Secy. and Treas., R. W. Kindle. Supt., Jno. Bassett.

NOTE.—The company also operates in same building with pumping machinery an electric light and ice plant. Figures given include cost of entire plant.

Water-Works Projected with Fair Prospects of Construction.

BALLINGER, *Runnels Co.* (Pop., est., 2,000.)
Proposed Works.—Address W. L. Towner, County Clerk.

BASTROP, *Bastrop Co.* (Pop., 1,546; est., 3,500.) On Colorado river, 28 miles from Austin.

Proposed Works.—Bastrop Improvement & Investment Co. had works under consideration in July, '89, but matter was somewhat indefinite. Supply, artesian wells. Est. cost, $20,000 to $25,000. Prest., J. C. Buchanan. Secy., D. F. Johnson.

BONHAM, *Fannin Co.* (Pop., 1,880; est., 3,000.) Has electric lights.
Proposed Works.—City has been trying since '88 to secure supply from artesian well. Feb. 8, '90, last attempt had failed and new contract had been let. Bonds to amount of $50,000 were voted in '88. City Clerk, Jas. K. Blair.

CISCO, *Eastland Co.* (Pop., est., 3,000.) Has coal mines.
Proposed Works.—J. H. Beal proposes to build. Supply, reservoir with area of 600 acres formed by dam across cañon, pumping to stand-pipe. Est. cost, $40,000. Report, Jan. 24, '90.

HUBBARD, *Hill Co.* (Pop., est., 1,200.)
Proposed Works.—Hubbard City Artesian Well & Water-Works Co. to begin construction May 1 and complete works Sept. 1, '90. Engr. in charge of surveys, B. E. Wells, Hubbard. Contracts not let, time of report. Supply, artesian well. Est. cost, $10,000 to $15,000. Cap. subscribed. Address H. H. Rowland, Tyler, or H. B. Morgan, Hubbard, directors of Co., or S. H. Sayer. Report, Mar. 25, '90.

LULING, *Caldwell Co.* (Pop., est., 2,500.)
Proposed Works.—Luling Water-Works Co. were trying to make contract with town in Feb., '90; nothing definite done toward construction. Supply, San Marcos river, pumping to stand-pipe. Est. cost, $18,000. One-half cap. had been secured May 27, '89. Unofficially reported, Mar., '90, that contract had been made with city, and in Apr. 300,000-gall. pump, 12 x 100-ft. stand pipe, 3 miles, 8 and 4-in. mains were wanted. Secy., Jno. Orchard.

MARLIN, *Falls Co.* (Pop., est., 1,400.) Is 3 miles from Brazos river.
Proposed Works.—Contract let by town to Thomas & Gorman to build works; when completed Contrs. will lease and operate in connection with ice factory and electric lighting plant. Report, about Mar. 20, '90.

MERIDIAN, *Bosque Co.* (Pop., est., 1,000.) On Bosque river.
Proposed Works.—Under consideration. Supply, artesian wells, pumping to stand-pipe. Address City Council or S. E. Moses, Morgan.

NACOGDOCHES, *Nacogdoches Co.* (Pop., est., 2,000.)
Proposed Works.—Under consideration. May be built jointly by city and Thomas & Gorman, Houston. Supply, spring-fed lake, by gravity. Est. cost, $35,000. Report, about March 10, '90.

ROCKDALE, *Milam Co.* (Pop., 1,185; est., 2,000.) Has manufactories.
Proposed Works.—Under consideration. City would pay $1,000 hydrant rental. Supply, wells or Good river, 4 miles distant. Report by Solon Jaynes; date, Jan. 21, 90.

SAN DIEGO *Duval Co.* (Pop., est., 1,500.)
Proposed Works.—Under consideration. Supply, creek, pumping from impounding to distributing reservoir. Est. cost, $2,500. Address L. B. Wright. Report, Dec 5, '89.

VERNON, *Wilbarger Co.* (Pop., est., 3,000.)
Proposed Works.—Vernon Ice, Light & Water Co., incorp. in spring of '90, with cap. of $60,000, by D. A. Turner and others. City Secy., Jno. Brown.

WICHITA FALLS, *Wichita Co.* (Pop., not given.)
Proposed Works.—Mar. 22, '89, franchise granted to E. W. Abendroth, Nelson Bldg., Kansas City, Mo.; stand-pipe, 4-miles mains, 35 hydrants, $2,450 yearly hydrant rental.

Water-Works Projects Reported in '89 and '90, but now Indefinite.

Baird, Callahan Co. *Brackettville*, Kinney Co. *Brownsville*, Cameron Co.; see MANUAL for '88, p. 490. *Caldwell*, Burleson Co. *Childress*, Childress Co. *Corpus Christi*, Nueces Co.; see MANUAL for '88, p. 490. *Dublin*, Erath Co. *Hempstead*, Waller Co. *Henrietta*, Clay Co.; see MANUAL for '88, p. 491. *Jefferson*, Marion Co. *McGregor*, McLennan Co. *New Birmingham*, Cherokee Co. *Waxahachie*, Ellis Co.; see MANUAL for '88, p. 491.

INDIAN TERRITORY.

Water-Works Completed and Projected.

CUTHRIE, *Oklahoma.* (Pop., est., 8,500.)

General Description.—Built in '89 by Jno. E. Ford, Newton, Kan. Used only for street sprinkling and fire protection. Supply, Dean pump lifts water to tank elevated about 40 ft. *Mains*, 4-in., 3½ miles.

NOTE.—Council entertaining several propositions to build extensive works. Mayor, Jas. Dooley. City Clerk, Geo. W. Paxton.

COLORADO.

Water-Works Completed or in Process of Construction.

ANTONITO, *Conejos Co.* (Pop., est., 500.)

NOTE.—Supplied from irrigating ditches of Taos Valley Co.

ASPEN, *Pitkin Co.* (Pop., est., 6,000). On Roaring Fork river, in mining region. Incorp. Partially sewered. Has electric lights.

History.—Built in '86 by Castle Creek Water Co. Engr., M. W. Mathers, Glenwood Springs.

Water Supply.—Castle and Hunter creeks, by gravity.

Dam.—Log, across creek; 15 ft. long, 2½ ft. high; diverts water to flume.

Flume.—Length, 2.2 miles.

Tank.—Cap., 20,000 galls.

Distribution.—*Mains*, kal. i., 5 miles. *Services*, kal. i. *Taps*, withheld, est., 150. *Meters*, none. *Hydrants*, Ludlow, 35. *Valves*, Ludlow.

Consumption, 500,000 galls. *Pressure*, 95 lbs.

Financial.—Cost, $130,000. Debt, $60,000: $10,000 at 18, $50,000 bonds at 8%. Ann. op. exp., $3,000. Ann. rev.: consumers, $12,000; city, $3,250. Hydrant rental, $100 for 30, $50 for additional.

Management.—Prest., H. P. Cowenhover. Gen. Mgr., J. H. Devereux. Supt., H. G. Koch.

BARNUM and VILLA PARK (WEST DENVER), *Arapahoe Co.* (Pop., not given.)

General Description.—Franchise granted in '89 or early in '90 to Mountain Water Co. Contract let to F. P. Arbuckle; price, $55,332. Pumps, Holly quadruplex. *Mains*, iron, 8 miles. *Hydrants*, 52.

BERTHOUD, *Larimer Co.* (Pop., est., 300.) Incorp. No sewers or electric lights.

History.—Built in '86 by Berthoud Ditch, Reservoir & Water Co.; bought by town in '89 for $12,000. Des. Engr., S. V. Saleno. Const. Engr. and Contr., A. L. Holmes, Grand Rapids, Mich.

Water Supply.—Surface water gathered in reservoir of 50 acres area, by gravity.

Distributing Reservoir.—Is 125 x 300 ft.

Distribution.—*Mains*, Wyckoff wood, 3 miles; from Michigan Pipe Co., Bay City. *Taps*, 40. *Meters*, none. *Hydrants*, Holly-Gaskill, 4. *Valves*, Galvin.

Consumption, unknown. *Pressure*, 45 lbs.

Financial.—Cost, $12,000. Cap. stock, $2,000. Debt (in '87), $5,500, of which $4,500 is in bonds. Int., 7%. Ann. op. exp., $100. Ann. rev.: consumers, $1,200.

Management.—Secy. and Supt., A. Fairbairn. Treas., Peter Turner.

BLACK HAWK, *Gilpin Co.* (Pop., 1,540.) Incorp. Partially sewered. Has electric lights.

History.—Built in '83-4 by town.

Water Supply.—Mountain springs, by gravity. Springs have dy. flow of 30,000 galls., and are 3 miles from city.

Reservoir.—Cap., 100,000 galls; in excavation on top of mountain, 390 ft. above town, collecting water from springs on higher mountain, through wooden pipes emptying into 5-in. main. Reservoir is lined with brick, laid in Portland cem. Overflow-pipe carries overflow of reservoir to a neighboring creek.

Distribution.—*Mains*, c. i., 7 miles. *Services*, w. i. *Taps* (in '87), 250. *Meters*, 2. *Hydrants*, kind not given, 16.

Consumption, 200,000 galls. *Pressure:* 115 lbs.

Financial.—Cost, $14,760. Debt, $14,760. Int., 8%. Ann. op. exp., $1,200. Ann. rev.: consumers, $4,500.

Management.—City Council. City Marshall, Wm. R. Backus.

BOULDER, *Boulder Co.* (Pop., 3,069; est., 4,000.) On Boulder creek. Engaged in coal, gold and silver mining. Settled in '59; incorp. city of second-class in '71. No sewers. Has electric lights.

History.—Built in '75 by town. Des. Engr., J. S. Titcomb, Denver.

Water Supply.—Boulder creek, by gravity to and from reservoir. Point of supply is about 1½ miles from town. Open ditch, one mile long, leads to reservoir.

Dam and Reservoir.—Cap., not given; between hills, 150 ft. above and ½ mile from city limits. Dam, of masonry, built between foot-hills.

Supply Pipe.—C. i., 10-in. for 1,000 ft., then reduced to 8-in. for 1,000 ft., when it branches into smaller sizes.

Distribution.—*Mains*, c. i., 8 miles. *Services*, w. i., lead. *Taps*, 450. *Meters*, none. *Hydrants*, Ludlow, Fowler, 40. *Valves*, Morgan.

Consumption, unknown. *Pressure*, 65 lbs.

Financial.—Cost, $50,000. Debt, $36,700: $19,200 at 10; $17,500 at 8%. Ann. op. exp., $508. Ann. rev.: consumers, about $6,000.

Management.—Supt., J. E. Bemus. Town Clerk, E. L. Coates.

BRECKENRIDGE, *Summit Co.* (Pop., 1,657.)

General Description.—Owned by town. Direct pumping system. *Mains*, 1¼ miles. *Hydrants*, 22. *Pressure*, 90 lbs. Secy., Wm. Forman.

BUENA VISTA, *Chaffee Co.* (Pop., est., 1,200.) On Arkansas river at an elevation of 7,500 ft. A mining and smelting town. Settled in '79. Incorp. city. No sewers. Has electric lights.

History.—Built in '83 by town. Des. Engr., B. C. Libby. Contrs., Colo. Machinery Co., Denver.

Water Supply.—Cottonwood creek, at point two miles from and 160 ft. above town, by gravity.

Distribution.—*Mains*, 10 to 4-in. asphalted c. i., kal. i., 3 miles. *Services*, not given. *Taps*, 125. *Meters*, none. *Hydrants*, Ludlow, 14. *Valves*, Ludlow.

Consumption, 40,000 galls. *Pressure*, 65 lbs.

Financial.—Cost, $32,500. Debt, $30,000. Int., 8%. Ann. op. exp., $50. Ann. rev.: consumers, $1,350.

Management.—City Clerk, T. H. McGiff. Supt., E. M. Kemble.

CANON CITY, *Fremont Co.* (Pop., 1,501; est., 3,100.) On Arkansas river. Incorp. city. Has sewers and electric lights.

History.—Built in '80 by Co. and sold to city.

Water Supply.—Ground water, by direct pumping.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two Blake, of 12-in. bore and 24-in. stroke, driven by water-power, or steam. Ice gives trouble to water-power in winter, and floods for about one month in summer.

Distribution.—*Mains*, c. i., 5 miles. *Services*, galv. i. *Taps*, about 300. *Meters*, none. *Hydrants*, kind not given, 24.

Consumption, about 1,000,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 120 lbs.

Financial.—Cost, about $60,000. Bonded debt, $60,000. Int., 7%. Ann. op. exp., $2,564. Ann. rev.: consumers, $7,254; city, $4,121.

Management.—Mayor, J. H. Maupin. Secy. and Supt., Y. T. Conaway.

CASCADE, *El Paso Co.* (Pop., est., 600.) Summer resort, 7,400 ft. above sea level. Not incorp. Has sewers. No electric lights.

History.—Built in '87 by Cascade Town & Improvement Co. to aid in developing town. Engr., Wm. Frizzell.

Water Supply.—Reservoir on Cascade creek, by gravity from elevated point in cañon.

Dam and Reservoir.—No data.

Distribution.—*Mains*, 8-in. iron, 3 miles. *Services*, galv. i. Pipe and specials from H. Watson, Alton, Ill. *Taps*, 22. *Meters*, none. *Hydrants*, Chapman, 7. *Valves*, Chapman.

Pressure, 200-ft. head.

Financial.—Cost, $10,000. No debt, op. exp. or rev.

Management.—Prest., D. N. Meizer. Secy. and Treas., W. W. Miller. Supt., Wm. Frizzell.

CENTRAL CITY, *Gilpin Co.* (Pop., 2,626; est., 7,000.) Engaged in milling, gold mining and smelting. Incorp. No sewers. Has electric lights.

WILSON BROS.' WORKS.

General Description.—Built in '73. Bought by town in '89. Supply from tank, source not given. *Mains*, over 2 miles.

CITY WORKS.

History.—Built in '86-9.

Water Supply.—Springs, by gravity.

Conduit.—Springs to reservoir. Length, 7 miles: 4 miles 6 to 3-in. Wyckoff, 3 miles pump-logs; to be replaced in '90 with 6 and 4-in. Wyckoff.

Reservoir.—Cap., about 525,000 galls.

Distribution.—*Mains*, c. i., 4 miles *Services*, not given. *Taps*, 250. *Meters*, kind not given, 12. *Hydrants*, Ludlow, 35. *Valves*, Ludlow.

Consumption, 26,400 galls. *Pressure*, 100 lbs.

Financial.—Cost, $80,000. Bonded debt, $45,000: $15,000 at 10; $30,000 at 7%. Ann. op. exp., $2,500. Ann. rev.: consumers, $8,400.

Management.—City Clerk, R. S. Haight. Supt., Jas. Davidson.

COLORADO CITY, *El Paso Co.* (Pop., 347; est., 3,000.) Engaged in mining, milling and smelting. Incorp. No sewers. Has electric lights.

History.—Built in '88 by Colorado City Water Co., under 20-years franchise. Engr., Anthony Bott. Contrs., Russell & Alexander, Colorado Springs.

Water Supply.—Sutherland creek, by gravity to reservoir.

Reservoir.—Cap., 8,000,000 galls.

Distribution.—*Mains*, c. i., 4 miles. *Services*, not given. *Taps*, 125. *Meters*, none. *Hydrants*, kind not given, 24.

Consumption, not given. *Pressure*, 100 lbs.

Financial.—Cost, $30,000. Cap. stock, $20,000. No debt. Ann. op. exp., withheld, est., $600. Ann. rev.: consumers, $1,500; city, none.

Management.—Prest., Treas. and Supt., A. Bott. Secy., J. K. Vanatta.

COLORADO SPRINGS, *El Paso Co.* (Pop. 4,226; est., 8,000.) On Monument creek on level plateau near Pike's Peak, at elevation of 6,022 ft. Health rep't. Has sewers and electric lights.

History.—Built in '79 by town. Des. Engr., W. B. Sherman.

In '86-7 works were extended with City Engr. H. L. Reid in charge.

Water Supply.—Buxton's creek, by gravity to distributing reservoirs. Point of supply is 7 miles from city, on eastern slope of Pike's Peak. Stream is fed from springs and perpetual snow.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Holly quadruplex.

Dam and Reservoirs.—Cap., 17,000,000 galls.; two, in excavation and embankment, about one mile from and 200 ft. above city; small dam across valley of stream, helping to form first, which has cap. of 2,000,000 galls. Bottom of larger reservoir is covered with 2 ft. of puddle, above which is 18 ins. of clean gravel. All pipes leading through banks of new reservoir are thoroughly bedded in hydraulic cements, with collars of same.

Conduit.—C. i., 10-in., 6 miles long, having fall of 1,000 ft.

New Supply Main: of 16-in. pipe, with 12, 10 and 8-in. sub-mains. Main from old reservoir has been retained, and two can be connected or used independently.

Distribution.—*Mains*, c. i., including conduit and supply pipes, 40 miles. *Services*, w. i., lead. *Taps*, 1,800. *Meters*, 51. *Hydrants*, Holly, Mathews, Ludlow, Chapman, 51. *Close of '80*: Mains, 13 miles. Taps, 450. Meters, none. Hydrants, 10.

Consumption, 1,500,000 galls. *Pressure*, 80 lbs.

Financial.—Cost, $300,000. Debt, $202,000: $25,000 at 7, $177,000 at 6%. Ann. op. exp., $3,000. Ann. rev., consumers, $22,600. Cost, close of '80, $80,000. Rev., '80, $7,000.

Management.— Secy., H. C. McCreery. Supt., Edw. Frost.

CRESTED BUTTE, *Gunnison Co.* (Pop., est., 1,000.) Engaged in gold, silver and coal mining. Has electric lights.

History.—Built in '89 by Crested Butte Light & Water Co.; put in operation about Oct. 1. Co. operates electric lights.

Water Supply.—Coal creek, by gravity to reservoir.

Conduit.—Length, 8,500 ft.

Reservoir.—Cap., 2,000,000 galls.; 290 ft. above town.

Distribution.—*Mains*, including conduit, 15,000 ft. *Hydrants*, 12.

Financial.—Cost, est., $16,000. Hydrant rental, $100. City also pays $300 for electric lights.

Management.—Prest., A. C. Wright. Secy. and Treas., S. J. Metzler. Supt., D. J. McCanne. Report, Aug. 14, '89.

DENVER, *Arapahoe Co.* (Pop., 35,629; est., 90,000.) At junction of South Platte river and Cherry creek, on a series of plateaux rising gently from river. Settled in '59. Altitude, 5,300 ft. Has sewers and electric lights.

DENVER WATER CO.

History.—Built in '71-2 by Denver Water Co. Engr., Jas. Archer. In '80 and again in '86, works were extended and the supply increased. Unofficially reported that this Co. and Denver City Water & Irrigation Co. combined in '82 as Denver City Water Co.

OLD WORKS.—'72 TO '80.

General Description.—Water was pumped directly to mains from South Platte river. A cribbed well was built in east bank of river at base of city. It was 42 x 56 ft., with branch extending towards river, 20 x 60 ft.; depth, 22 ft. For first 10 ft. walls were timber with 4 ft. of broken stone in center. The remaining 12 ft. was of stone. Well was roofed. After few years, pipe was laid to river for use in case of fire.

Pumps were Holly, there being 6 gang pumps and 4 rotary, with combined dy. cap. of 2,500,000 galls. These works were abandoned with completion of the new plant, described below.

NEW PUMPING WORKS.—BUILT IN '80.

Water Supply.—Vertical and horizontal wells along bank of So. Platte river, by gravity through conduit to reservoir, thence by direct pumping. First supply from this plant was from river through canal to artificial lake, with filter in forebay, thence by direct pumping. A fall of 28 ft. in canal affords water-power for pumping, which is still used.

Dam.—Masonry for 160 ft. in length, then of brush, clay and piling.

Canal.—About 2¼ miles long, 7 ft. deep, 35 ft. wide at bottom, and 50 at top.

Archer Lake.—The canal widens into basin covering, with area of canal, 40 acres, and having depth of 88 to 20 ft.

Wells.—Along low banks of Platte river, horizontal, about 1,200 ft. long, built up of redwood staves, some rectangular and some semicircular in section. Staves are joined at ends by sheet iron let into saw-kerf and held together by coated ⅝-in. rods, or hoops. Spaces of ⅜ ins. are left between staves to admit water.

Conduit.—Dy. cap., 16,000,000 galls. A 4-ft. conduit extends from wells about ⅜ miles to small reservoir; crosses river.

Reservoir.—About 300 by 400 ft.; paved with stone in cem.

Pumping Machinery.—First 4 pumps were driven by water-power and had cap. of 1,500,000 galls. each. Two 54-in. American turbines, giving 250-H. P. each when worked under a head of 30 ft., were first used. In '86 one of those was replaced by double Leffel wheel of over 300-H. P.

In '81 two 3,000,000-gall. Holly steam pumps were added, and in '82 these were reinforced by 400-H. P. Holly engines, and four 4½ x 18-ft. boilers. All of power from water and steam may be applied to main shaft, which is continuous and drives 6 horizontal pumps, or all pumps may be run by water or by steam, or any pair of of them. Steam power is used only during irrigating season.

Electric Lighting.—A 16-in. water-wheel driven by waste water from turbine drives a 150-light 16 c. p. Edison dynamo, saving $20 a month over lighting by kerosene oil. In day time this power is used for machine shop.

GRAVITY WORKS.—BUILT IN '86.

Water Supply.—Horizontal and vertical wells in bed of Cherry creek, 8 miles from center of city, by gravity to distributing reservoir and stand-pipe. Horizontal wells were similar to those described above, and from 12 to 13 ft below surface. Vertical wells Nos. 1, 3 and 4 are each 10 ft. in diam., constructed of 2 x 6-in. rough lumber cased with oak to within few ft. of the surface, from which point hard-burned brick are used and the top arched over with them. Well No. 2 is larger than others. Wells are from 20 to 25 ft. deep, and within each one is a second, perforated well, tapering from 30-ins. at bottom to 12 at top. These are also of timber, and extend to bed rock, about 35 ft.

Conduit.—Dy. cap., 10,000,000 galls.; 37 ins. in diam., about 7 miles long; wood. A general grade of 1-20 in 100 was established, but in several places this is not followed. There are several curves in the conduit. The deepest cut was from 9 to 21 ft., and in this 3-in. Colorado pine staves were used, and in others, 2-in. In depressions native lumber was used and other higher elevations California redwood, while in some places lower portion was built of pine and upper of redwood. Conduit was banded with ½-in. iron rods, spaced according to internal pressure, with three as a factor of safety.

Reservoir.—Cap., 7,000,000 galls.; in embankment, 120 x 559 ft., and 30 ft. deep. Bottom has a fall of 18 ins. Outer slopes, 2 to 1; inner, 1½ to 1. Banks are 14 ft. wide on top, and are carried 3 ft. above water. It is not lined. Wooden roof, supported on wooden posts, covers reservoir; sheathing of roof is not close, there being spaces from ½ to 1 in. between boards. About one-fifth of area of roof consists of trap doors, which are opened in fall to provide against heavy strains from snow. Roof has prevented growth of algæ in the reservoir, which would otherwise have proved very troublesome.

Stand-Pipe.—To equalize pressure. Is of California redwood, joined to redwood pipe by large casting with two horizontal and one vertical bell ends. Pipe is braced by 4 tubes tied together with rods, extending from near top of pipe to ground, where each tube rests on 8 tons of masonry. These tubes also serve as overflow pipes. They are in 3 sections of 6, 5 and 4-in. inside diam. from bottom up.

Remaining facts apply to the whole system.

Distribution.—(In '87.) *Mains*, c. i., 60 miles. *Services*, lead. *Taps*, 5,000. *Meters*, 20. *Hydrants*, Holly, 350. *Valves*, Eddy.

Consumption (in '87), 5,500,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—(In '87.) Cost, $1,200,000. Cap. stock, $1,500,000. Bonded debt $500,000. Int., 7, 8 and 10%. Ann. op. exp., withheld, est., $60,000. Ann. rev.: consumers, withheld, est., $160,000; city, $20,000 for hydrants and street sprinkling; new contract provides for rental after May 1, '91, of $35 each for 10 years of all hydrants placed May 1, '91, and $25 each for next 10 years.

Management.—Prest., Dennis Sullivan. Secy., Peter McManus.

NOTE.—Some of the novel features of this system, such as the horizontal wells, the redwood conduit and stand-pipe, the reservoir roof and the growth of algæ in the reservoirs, are described and illustrated in detail in *Engineering News*, vol. XIX., pages 333-4, and vol. XX., pages 222-3, 240-2. The articles in vol. XX. are by S. Fortier.

NOTE.—No report for '88 could be obtained. Mar., '89, there was a disagreement among stockholders and E. F. Hallock, Chas. Hallock, W. S. Cheesman, Geo. W. Kassler and D. H. Moffatt withdrew, and incorp. the Citizens' Water Co. (See below.) Franchise of Denver Water Co. expires May 9, '91, and in Apr., '90, franchise was renewed for 20 years from expiration of old franchise. Co. paid $25,000 for 498 hydrants already placed and owned by city. The Denver Water Co.'s works were being extended, spring of '90. Unofficially reported, spring of '90, that American Water-Works Co., Omaha, Neb., had become interested in these works.

CITIZENS' WATER CO.

History.—Organized (see above Note) and began construction in '89. High-service and 36-in supply main was to be in operation July 1, '90; low-service and 48-in. supply main, May 1, '90. Engr., Chas. P. Allen. Consult. Engr., E. S. Nettleton, Denver.

Water Supply.—No. Platte river, by gravity. Source is at point where river emerges from Rocky Mts., about 17 miles from city.

Storage Reservoir.—Cap., 5,000,000,000 galls; in mountains.

Conduits.—A 36-in. high, 48-in. low service.

Distributing Reservoirs.—Cap., 30,000,000 galls.; 20,000,000 and 10,000,000. At city.

Distribution.—(As projected.) *Mains*, 80 miles. *Services*, lead.

Pressure: (est.) Ordinary, 75 lbs. Fire, 125 lbs.

Financial.—Cost, est., $2,000,000. Cap. stock, authorized, $3,000,000.

Management.—Prest., David H. Moffatt. V. Prest., E. F. Hallock. Secy. and Mgr., Richard Holme. Treas., First National Bank. Report, Sept. 28, '89.

DURANCO, *La Plata Co.* (Pop., 2,500; est., 3,000.) On Animas river, in mining region. Settled and incorp. town in '80.

History.—Built in '83-4 by town. Des. Engr., C. M. Perin. Contr., So. Pueblo Machinery Co.

Water Supply.—Animas river, pumping to reservoir.

Dam and Reservoir.—Cap., about 500,000 galls.; 100 ft. sq. x 8 ft. deep; 350 ft. above pumps. Outer slope 2 to 1; inner slope, 1 to 1, puddled with clay. Dam of logs rock and earth, 6 ft. high.

Pumping Machinery.—Dy. cap., 500,000 galls.; two Deane. Originally two Leffel water-wheels drove a 9-in. pump of 24-in. stroke, made by Contrs.

Distribution.—(In '87.) *Mains*, 10 to 4-in. c. i., 3½ miles. *Services*, galv. i. *Taps*, 150. *Meters*, 1. *Hydrants*, 25.

Consumption (in '87), 150,000 galls. *Pressure*, 165 lbs.

Financial.—(In '87.) Cost, $80,000. Bonded debt, $80,000. Int., 8%. Ann. op. exp., $4,000. Ann. rev.: consumers, $3,500.

Management.—Supt., Chas. S. Butler.

NOTE.—No report for '89 could be obtained.

FAIRPLAY, *Park Co.* (Pop., 450; est., 750.) At head of South Park, at elevation of 9,674 ft. Engaged in gold and silver mining.

History.—Built in '82 by village, under direction of Geo. W. Nyce. Contr., Jas. W. Rich.

Water Supply.—Spring, by gravity to and from reservoir.

Ditch.—From spring to reservoir; is 3 ft. wide, 1¼ ft. deep, ¾ miles long.

Reservoir.—In excavation, 50 x 150 ft. at bottom, 90 x 220 ft. at top, 78 ft. above, and 2,500 ft. from center of town.

Distribution.—(In '87.) *Mains*, lap-welded w. i., 3½ miles. *Services*, galv. i., black i. *Taps* (in '86), 75. *Meters* (in '86), none. *Hydrants*, 35.

Consumption, unknown. *Pressure*, 40 lbs.

Financial.—(In '87.) Cost, $10,000. Debt, $8,500. Int., 8%. Ann. op. exp., about $300. Ann. rev.: consumers, about $600.

Management.—(In '88.) Supt., Geo. W. Nyce. Town Clerk, P. S. Hickey.

NOTE.—No report for '89 could be obtained.

FORT COLLINS, *Larimer Co.* (Pop., 1,356; est., 3,000.) On Cache la Poudre river on level ground. Settled in '65; incorp. city in '73. Has sewers and electric lights.

History.—Built in '82-3 by city. Engr., H. P. Handy, Fort Collins. Contrs. Russell & Alexander, Chicago, Ill.

Water Supply.—Cache la Poudre river, by gravity to settling reservoir, then by gravity to second reservoir, thence by direct pumping. Point of supply is about 5 miles west of city.

Filter.—At river; wooden crib filled with cobblestone and gravel. From this, open canal leads 400 ft. to settling reservoir.

Settling Reservoir.—Cap., 3,000,000 galls.

Dam and Reservoir.—Cap., 2,000,000 galls. Dam, of earth, with center of 3-in. spruce plank. Open canal 10 ft. wide and 6 ft. deep conveys water to reservoir at pump.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; two 750,000 Gaskill water-power. *Water-wheels:* two 36-in. American turbines of 150 H. P., under 22 ft. head.

Force Main.—Of 12-in. lap-welded w. i., about 3½ miles long.

Distribution.—*Mains*, 10 to 3-in., lap-welded w. i., 11 miles, including force main. *Services*, galv. i., lead. *Taps*, 379. *Meters*, none. *Hydrants*, Holly, 45, *Valves*, Holly.

Consumption, 1,000,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 120 lbs.

Financial.—Cost (in '87), $105,000. Debt, $105,000: $20,000 at 8, $85,000 at 7%. Ann. op. exp., $2,500. Ann. rev.: consumers, $6,753.

Management.—Supt., C. B. Rosenow.

GEORGETOWN, *Clear Creek Co.* (Pop., 3,294; est., 2,500.) Engaged in mining.

History.—Built in '74 and extended in '86-7 by Clear Creek Water Co., under 20-years franchise.

Water Supply.—Clear creek, by gravity.

Settling Basins.—First is 30 x 30 ft., x 5 ft. deep, of stone. Second is 60 ft. in diam., 8 ft. deep, of wood and stone.

Reservoir.—Is 12 x 20 ft, x 17 ft. deep, lined with brick and cem.

Distribution.—(In '87.) *Mains*, c. i., 3 miles. *Services*, lead. *Taps*, withheld, est., 125. *Meters*, none. *Hydrants*, Ludlow, 19. *Valves*, Ludlow.

Consumption, not given. *Pressure:* Ordinary, 60 lbs. Fire, 120 lbs.

Financial.—(In '87). Cost, $35,000 No debt. Ann. op. exp., about $2,500. Ann. rev.: consumers, withheld, est., $3,000; city, $1,450. Hydrant rental, $125, $75 and $50, according to number.

Management.—Prest., A. R. Forbes. Secy., O. C. Warner. Treas., C. R. Fish. Supt., H. Nash.

GLEN PARK, *El Paso Co.* See Palmer Lake.

GLENWOOD SPRINGS, *Garfield Co.* (Pop., est., 1,000.) At junction of Grand and Roaring Fork rivers. Has hot springs. Incorp. town. No sewers. Has electric lights.

History.—Built in '88 by Glenwood Light & Water Co. Engr., Mason W. Mather. Co. operates electric lights and water-power plant with 6 100-H. P. Pelton water-wheels, under 468-ft. head.

Water Supply.—No Name creek, by gravity.

Conduit.—In 3 sections. First is wooden flume, 7,220 ft. long; second, 6,000 ft. of 24, 20, 18 and 16-in. pipe to pump-house; third is an 8-in. branch extending across Grand river, conveying water direct to mains; river section was laid as one piece from staging built across river. It is anchored by iron stakes driven on its lower side. Pressure regulator was placed at end of this section. Head at river is 466 ft.

Distribution.—*Mains* (in '86), 24 to 4-in. kal. i., 5¼ miles; from National Tube Works Co., McKeesport, Pa. *Services* and *Taps*, withheld, est., 125. *Meters*. 1. *Hydrants*, 17.

Consumption, 1,500,000 galls. *Pressure*, 48 to 200 lbs.

Financial.—Cost, including water-power plant, $125,000. No debt. Ann. op. exp., withheld, est., $800. Ann. rev.: total, withheld, est., $300. Hydrant rental, $50.

Management.—Prest., F. H. H. Doyle. Secy., T. H. Edson. Gen. Mgr., Mason W. Mather.

GOLDEN, *Jefferson Co.* (Pop., 2,730; est., 3,500.) On Clear creek, fork of South Platte river, at elevation of 5,600 ft. Engaged in mining, smelting, and in manufacturing flour, glassware, drain tile, pottery and brick. Settled in '59. Incorp. city in '72. Has electric lights.

History.—Built in '79 by city. Principal Contrs., Russell & Alexander, Chicago, Ill.

Water Supply.—Infiltration from irrigating canal to two reservoirs, pumping direct.

Reservoirs.—Two; each 150 ft. in diam., 12 ft. deep, excavated in gravel bed.

Pumping Machinery.—Dy. cap., 1,500 000 galls.; Holly, quadruplex.

Distribution.—*Mains*, c. i., 6¼ miles. *Services*, lead. Pipe and specials from Dennis Long & Co., Louisville, Ky. *Taps*, 300. *Meters*, none. *Hydrants*, Holly, 30. *Valves*, Holly.

Consumption, 600,000 galls. *Pressure:* Ordinary, 75 lbs. Fire, 150 lbs.

Financial.—Cost, $55,000. Bonded debt, $50,000. Int., 8%. Ann. op. exp., about $4,500. Ann. rev.: consumers, about $4,500; city, $2,000.

Management.—Supt., W. M. Sarell.

GRAND JUNCTION, *Mesa Co.* (Pop., est., 1,500.) On Grand river.

History.—Built in '88-9 by Grand Junction Water Co., under 20-years franchise. Engr., J. S. Simmons.

Water Supply.—Grand river, pumping to stand-pipe.

Stand-Pipe.—Cap., 58,800 galls.; 10 x 100 ft.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Knowles.

Distribution.—(In '88.) *Mains*, iron and cem., 4 miles. *Services*, *Taps* and *Meters*, not given. *Hydrants*, 50.

Financial.—(In '88.) Cost, est., $60,000. Cap. stock, $60,000. Hydrant rental, $3,250 for 50 hydrants, or $65 each.

Management.—Prest., W. G. Reeve, Peru, Ill. Secy., W. J. Park, Larned, Kan. Supt., W. J. Krusen.

NOTE.—No report for '89 could be obtained.

CREELEY, *Weld Co.* (Pop., 1,297; est., 3,000.) On Cache la Poudre river. Has lumber industries. Incorp. Has sewers and electric lights.

History.—Built in '89 by city; put in operation about June 1. Engr., C. P. Allen, Denver.

Water Supply.—Well and galleries, pumping to stand-pipe. Well, 14 ft. in diam., 16 ft. deep.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Gaskill dup. *Boiler:* Hazleton.

Stand-Pipe.—Cap., 158,000 galls.; 30 x 30 ft.

Distribution.—(As designed.) *Mains*, 11 miles. *Hydrants*, Chapman, 50. *Pressure:* 66 to 75 lbs.

Financial.—(June 1, '89.) Cost, about $63,000. Debt, $65,000.

Management.—City Clerk, E. F. Dawley. Report, May 17, '89.

GUNNISON, *Gunnison Co.* (Pop., 888; est., 2,000.) On Gunnison river. Engaged in mining. Settled about '76. Incorp. No sewers. Has electric lights.

History.—Built in '82 by Gunnison Gas & Water Co., under 25-years franchise. Engr., D. J. McCanne, present Supt. Contr., Carroll E. Gray, Jr., Chicago, Ill.

Water Supply.—Gunnison river, pumping to tanks and direct. River is swift mountain stream draining about 1 sq. m.

Conduit.—Stone and brick, leading 2,000 ft. from river to pumps.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; two 750,000 Worthington, comp., dup.

Tanks.—Cap., 60,000 galls.

Distribution.—*Mains*, c. i., kal. i., 3½ miles. *Services*, galv. i., lead. *Taps*, 105. *Meters*, 1. *Hydrants*, kind not given, 52.

Consumption, 100,000 galls. *Pressure:* Ordinary, 85 lbs. Fire, 100 lbs.

Financial.—Cost, $85,929. Cap. stock, $200,000. No debt. Ann. op. exp., $3,592. Ann. rev.: consumers, $3,043; city, $3,700. Hydrant rental, $100.

Management.—Prest., B. W. Lewis. V. Prest., J. N. Schoonmaker. Supt., D. J. McCanne.

NOTE.—Above same as in MANUAL for '88, Supt. reporting that there was practically no change.

HIGHLANDS, *Arapahoe Co.* (Pop., est., 7,000.) Incorp. No sewers or electric lights.

History.—Built in '87 by Beaver Brook Water Co., under 20-years franchise. Supplies part of No. Denver. Engr., B. P. Arbuckle. Contr., A. L. Holmes.

Water Supply.—Artesian wells, pumping to tank.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; one 750,000 Gaskill dup. and one from Fairbanks, Morse & Co., Chicago.

Tank.—Cap., not given; 400 ft. high.

Distribution.—*Mains*, 6 to 2-in. Wyckoff wood, 12½ miles. Pipe and specials from Michigan Pipe Co., Bay City, Mich. *Services* and *Meters*, not given. *Taps*, 520. *Hydrants*, Gaskill, 76. *Valves*, Galvin.

Consumption, 1,000,000 galls. *Pressure*, not given.

Financial.—Cost, $89,000. Debt, $48,000. Int., not given. Ann. op. exp., $6,000. Ann. rev.: consumers, $7,500; city, $4,000. Hydrant rental, $40.

Management.—Prest., H. B. Chamberlin. Secy. and Supt., B. P. Arbuckle.

HOLYOKE, *Phillips Co.* (Pop., est., 1,200.) Incorp. city. No sewers or electric lights.

History.—Built in '89 by Lincoln (Neb.) Land Co.; put in operation about Oct. 15. Des. Engr., C. H. Meeker. Const. Engr. and Contr., Ben S. Clarke, Holdredge, Neb.

Water Supply.—Well, [probably] pumping to stand-pipe.

Pumping Machinery.—Dy. cap., not given.

Stand-Pipe.—Cap., 64,000 galls.; 10 x 110 ft., from W. J. Cooper & Cole Bros. Lincoln, Neb.

Distribution.—*Mains*, c. i., 5 miles; from W. J. Cooper & Cole Bros., Lincoln, Neb. *Hydrants*, Eclipse, number not given. *Valves*, Arthur.

Financial.—Cost, about $30,000. Debt, not given. Int., 6%. Hydrant rental, $60.

Management.—Address Lincoln Land Co., Lincoln, Neb. Report about July 1, '89.

IDAHO SPRINGS, *Clear Creek Co.* (Pop., 733; est., 2,000.) Has mineral springs. Incorp. No sewers. Has electric lights.

History.—Built in '80 by city.

Water Supply.—Mountain stream, by gravity to reservoirs.

Reservoirs.—Dy. cap., 1,450,000 galls.; one 1,000,000 and one 450,000 galls.

Distribution.—*Mains*, 10 to 4-in. c. i., 2 miles. *Services*, wood. *Taps*, 137. *Meters*, none. *Hydrants*, Mohawk, Ludlow, 21.

Consumption, unknown. *Pressure:* Ordinary, 90 lbs. Fire, 120 lbs.

Financial.—Cost, $30,000. Debt, $20,000. Int., 8%. Ann. op. exp., $1,300. Ann. rev.; consumers, $2,248.

Management.—Supt., H. O. Walker.

LA JUNTA, *Bent Co.* (Pop., est., 1,500.) On Arkansas river.

History.—Built in '82-3 by A. T. & S. F. R. R. Co., now owned by La Junta Water Co. Des. Engr., A. A. Robinson, Topeka, Kan. Const. Engr., W. H. Earl, Newton, Kan.

Water Supply.—Well, 20 ft. in diam., pumping to tank and direct.

Pumping Machinery.—Dy. cap., 950,000 galls.; two Knowles, one being comp., dup. with 10½-in. cylinders.

Tanks.—Cap., 100,000 galls.; two, each 24 x 16 ft., on 25-ft. posts.

Distribution.—*Mains*, c. i., 3.3 miles. *Services*, w. i. *Taps*, 211. *Meters*, none. *Hydrants*, Holly, 14.

Consumption, 450,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—Cost, $30,000. No debt. Ann. op. exp., $3,300. Ann. rev.: consumers, about $3,530, of which $960 is from R. R. Co.; city, $430. Hydrant rental, $72.

Management.—Supt., W. A. Drake, Pueblo, Colo. Treas., E. Wilder, Topeka, Kan.

LAKE CITY, *Hinsdale Co.* (Pop., est., 800.) On Lake fork of Gunnison river. Engaged in silver mining. Incorp. town. No sewers or electric lights.

History.—Built in '90 by town; expected to have in operation April 15. Contr., S. T. Wicks, Colorado Springs.

Water Supply.—Lake fork of Gunnison river, by gravity from impounding reservoir.

Dam and Impounding Reservoir.—Cap., not given; reservoir 2,000 ft. long; about 1 mile from town.

Distribution.—*Mains*, 10 to 6-in. spiral steel, 4-in. American lap-welded w. i., 2.8 miles. *Services*, ¾-in. *Meters*, none. *Hydrants*, Holly, 17. *Valves*, Eddy.

Pressure, 67 lbs.

Financial.—Cost, $19,000. Bonds, authorized, $25,000.

Management.—No appointments made. City Clerk, A. M. Wilson Reports, Dec. 11, '89, Feb. 13, '90.

LAMAR, *Prowers Co.* (Pop., est., 1,500.) Incorp. No sewers or electric lights.

History.—Built in '87; now owned by city, who bought them from Lamar Water Co. Engrs. and Contrs., F. P. Arbuckle, Denver, and A. L. Holmes, Grand Rapids, Mich.

Water Supply.—Nine 2½-in. driven wells, pumping to tank and direct.

Tank.—Cap., 100,000 galls.

Pumping Machinery.—Dy. cap., 500,000 galls.; Knowles dup.

Distribution.—*Mains*, Wyckoff, 4 miles. Pipe and specials from, and trenching and pipe-laying done by Michigan Pipe Co., Bay City. *Services*, ¾-in. iron. *Taps*, 100. *Meters*, none. *Hydrants*, Holly-Gaskill, 20.

Consumption, 100,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 130 lbs.

Financial.—Cost, $22,000. Bonded debt, $22,000. Int., 6%. Ann. op. exp., $2,000. Ann. rev. (in '87): consumers, $2,000; city, $1,500.

Management.—City Council. Report by F. A. Seeley, Seneca, Kans.

LAS ANIMAS, *Bent Co.* (Pop., 52; est., 2,000.) Incorp. Sewers and electric lights projected in '89.

History.—Built in '89 by city; put in operation about July 25. Des. Engr., Galen W. Pearsons, Kansas City, Mo. Const. Engr., W. C. Burke. Contr., Frank B. Arbuckle, Denver.

Water Supply.—Open well, near river, pumping to tank and direct. Well is 20 ft. in diam., 25 ft. deep, having dy. cap. of 1,200,000 galls.

Pumping Machinery.—Dy. cap., 1,100,000 galls.; two Deane comp., non-cond., dup. *Boilers:* two, 45-H. P.

Tank.—Cap., 90,000 galls.; 51 ft. high.

Distribution.—*Mains*, c. i., 3 miles. *Services*, w. i. *Taps*, 100. *Meters*, none. *Hydrants*, Holyoke, 30.

Consumption, 20,000 galls. *Pressure:* Ordinary, 25 lbs. Fire, 100 lbs.

Financial.—Cost, $30,000. Bonded debt, $30,000. Int., 8%. Sinking fund, $2,000. Ann. op. exp., $1,600. Ann. rev.: consumers, est., $1,200.

Management.—Supt., L. E. Boomer.

LEADVILLE, *Lake Co.* (Pop., 14,820; est., 20,000.) At head of Arkansas river, 10,500 ft. above sea. Produces large quantities of lead and silver. Settled in '78; incorp. city in '79. Has sewers and electric lights.

History.—Built in '79 by Leadville Water Co., under 20-years franchise. Contrs., Russell & Alexander, Chicago, Ill.

Water Supply.—Mountain streams, by gravity and pumping to reservoir Largest stream has a drainage area of 16 sq. m.

Dam and Impounding Reservoir.—Cap., 20,000,000 galls. Dam across gulch, 1½ miles from city.

Conduit.—In '81, 2,200 ft. of 12-in., and 5,364 ft. of 6-in. pipe connected reservoirs.

Distributing Reservoirs.—Cap., 10,000,000 galls.; built in '89 and have cap. of 5,000,000, 3,000,000 and 2,000,000 galls., respectively.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Cameron. *Boilers:* steel.

Distribution.—*Mains*, c. i., kal. i., 5 miles. *Services*, w. i., lead. *Taps*, 1,000. *Meters*, none. *Hydrants*, Holly, 135. *Valves*, Peet, Ludlow.

Consumption, 1,000,000 galls. *Pressure:* Ordinary, 80 lbs. Fire, 150 lbs.

Financial.—Cost, $500.000. Cap. stock. $300,000. Bonded debt, $200,000. Int., 8%. Ann. op. exp., $15,000. Ann. rev.: consumers, $35,000; city, $12,000. Hydrant rental, $125 for 10, $85 for additional.

Management.—Prest. and Treas., Wm. E. Hawks, Bennington, Vt. Supt. and Secy., C. N. Priddy.

LONGMONT, *Boulder Co.* (Pop., 733; est., 1,800.) On St. Vrain river on undulating ground. Settled in '70; incorp. town in '73. No sewers. Has electric lights.

History.—Built in '82 by town. Des. Engr., Daul. Ransom.

Water Supply.—South St. Vrain river, filtered, by gravity to and from reservoir. Point of supply is 10 1-6 miles from town, above all villages and camps on river. Formerly supply was 1 1-6 miles nearer town.

Filter Gallery.—Is a horizontal well, 110 ft. long, 4 ft. wide, 2½ ft. high, open on bottom, 14 ft. below surface. Soil, boulders and coarse gravel.

Conduit.—Of 8-in. vitrified tile; carries water into old well, old supply being cut off.

Reservoir.—Cap., 665,000 galls.; in excavation, with brick walls and floor, roofed with corrugated iron; 112 ft. above town.

Distribution.—*Mains*, w. i., 15¾ miles, including conduit. *Services*, galv. i. *Taps*, 380. *Meters*, 1. *Hydrants*, Bailey, 36. *Valves*, Eddy.

Consumption, 185,000 galls. *Pressure:* Ordinary, 80 lbs. Fire, 135 lbs.

Financial.—Cost, $75,000. Debt, $70,000. Int., 8%. Ann. op. exp., $600. Ann. rev.: consumers, $6,250.

Management.—Supt., Geo. W. Brown.

LOVELAND, *Larimer Co.* (Pop., est., 1,000.) Incorp. No sewers. Has electric lights.

History.—Built in '87 by city. Des. Engr., E. Leisher. Const. Engr., A. L. Holmes, Grand Rapids, Mich. Contrs., Michigan Pipe Co., Bay City.

Water Supply.—Little Canon of Big Thompson river, by gravity.

Distribution.—*Mains*, 6 in. Wyckoff wood, 11¾ miles. *Services*, wood, 2 and 3-in. *Taps*, 152. *Meters*, none. *Hydrants*, Holly, 12.

Consumption, not given. *Pressure*, 100 lbs.

Financial.—Cost, $41,650. Bonded debt, $41,000. Int., 7%. Ann. op. exp., $300. Ann. rev.: consumers, $160; city, $2,300. Hydrant rental, $12.

Management.—City Council. Supt., D. James.

MANITOU SPRINGS, *El Paso Co.* (Pop., est., 1,120.) Summer resort. Has sewers and electric lights.

History.—Built in '87-8 by town. Des. Engr., L. A. Pease. Const. Engr., Wm. Frizzell.

Water Supply.—French's creek, by gravity to reservoir. Source of creek is on Pike's Peak; dy. cap., 800,000 galls.

Reservoir.—Cap., 2,000,000 galls.

Distribution.—*Mains*, c. i., 2¾ miles. *Services*, not given *Taps*, 100. *Hydrants*, Ramsey, 18. *Valves*, Chapman.

Consumption, 500,000 galls. *Pressure*, 85 lbs.

Financial.—Cost, $40,000. Bonded debt, $40,000. Int. 6%. Ann. op. exp., $500. Ann. rev.: consumers, $4,000.

Management.—Mayor, I. Davis. City Clerk, H. H. Grafton. Supt., M. F. Bowers.

MONTROSE, *Montrose Co.* (Pop., est., 1,500.) Incorp. No sewers. Has electric lights.

History.—Built in '88 by town. Engr., E. B. Sawyer. Contrs., Holmes & Wicks, Colorado Springs.

Water Supply.—River, pumping direct.

Pumping Machinery.—Dy. cap., 750,000 galls.; Deane. *Boilers:* two, 45-H. P.; second from Erie City Iron Works; put in in '89.

Distribution.—*Mains,* 2¼ miles. *Taps,* 98. *Meters,* none. *Hydrants,* 11.

Consumption, 300,000 galls. *Pressure,* not given.

Financial.—Cost, est., $22,000. Bonded debt, $20,000. Int., 6%. Ann. op. exp., about $3,000. Ann. rev.: consumers, about $3,600.

Management.—Supt., F. H. Reinhold.

MORRISON, *Jefferson Co.* (Pop., 186; est., 250.) No sewers or electric lights.

History.—Built in '85-6 by Morrison Water Co., under 20-years franchise.

Water Supply.—Bear creek, by gravity.

Distribution.—*Mains,* w. i., 0.8 miles. *Services,* w. i. and lead. *Taps,* 25. *Meters,* none. *Hydrants,* none.

Consumption, unknown. *Pressure,* 48 lbs.

Financial.—Cost, $3,500. Cap. stock, $5,000. No debt. Ann. op. exp., $50. Ann. rev.: consumers, $340

Management.—Board of Directors. Prest., P. Christinsen. Secy. and Treas., W. S. Smith.

OURAY, *Ouray Co.* (Pop., 864; est., 2,000.) On Uncomphagre river, in gold and silver mining section. Incorp. No sewers. Has electric lights.

History.—Built in '81 by town.

Water Supply.—Canon creek and spring, by gravity.

Conduit.—A 6-in., 14,800 ft. from spring to reservoir; laid in '89.

Reservoir.—Cap., 1,000,000 galls.

Supply Main.—Length 5,000 ft.; laid in '89 to connect reservoir and distribution.

Distribution.—(In '87.) *Mains,* c. i., 2 miles. *Services,* not given. *Taps,* withheld, est., 100. *Meters,* none. *Hydrants,* 10.

Consumption, 252,000 galls. *Pressure:* Fire, 150 lbs.

Financial.—Cost, $22,500. Bonded debt, $20,000. Int., 8%. Ann. op. exp., $1,200. Ann. rev.: consumers, $3,500.

Management.—Board of Trustees. Report by M. S. Corbett.

PALMER LAKE, *El Paso Co.* (Pop., est., 1,000.) Incorp. No sewers or electric lights.

History.—Built in '87 by Palmer Lake Water Co., under 20-years franchise. Des. Engr., J. H. Drinkwater. Const. Engr. and Contr., A. L. Holmes, Grand Rapids, Mich. Supplies Glen Park.

Water Supply.—Monument creek, by gravity.

Reservoir.—On creek, size not given.

Distribution.—*Mains,* 3 and 4-in. Wyckoff wood, 3 miles. Pipe and specials from Michigan Pipe Co., Bay City. *Services,* not given. *Taps,* 87. *Meters,* none. *Hydrants,* 5.

Consumption and *Pressure,* not given.

Financial.—Cost, $7,000. No debt. Ann. op. exp., $50. Ann. rev.: consumers, $300; city, $800. Hydrant rental, $50.

Management.—Prest., W. H. Thompson. Secy. and Treas., J. H. Drinkwater, 29 Opera Block, Denver. Supt., W. Hughes.

PUEBLO, *Pueblo Co.* (Pop., 3,217; est. pop. supplied, 11,000. At junction of Arkansas and Fountain-qui-bouille rivers, at foot of Rocky Mts., on rolling prairie and elevated table lands. So. Pueblo, on opposite side of river, has been consolidated with Pueblo, but retains a separate post-office. Settled in '58; incorp. city in '70. Has sewers and electric lights.

History.—Built in '74-5 by city. Engr., Jas. A. Richardson. Contrs., National Building Assoc., St. Louis, Mo. So. Pueblo has separate works, described farther on.

Water Supply.—Arkansas river, by gravity to settling reservoirs, thence by direct pumping.

Dam.—Across river, not described.

Conduit.—From dam to reservoir, about 2 miles long.

Settling Reservoirs.—Cap., 20,000,000 galls.; three; area, 5 acres each. Des. Engr., Galen W. Pearsons, Kansas City, Mo.

Conduit.—To pumps; 2,000 ft. 14-in. c. i. Vitrified stoneware pipe was first used, but it proved unsatisfactory.

Pumping Machinery.—Dy. cap., 4,000,000 galls.; Holly quadruplex and Gaskill horizontal. Two 3,500,000 Gaskill horizontal are reported as added in '89.

Distribution.—*Mains*, c. i., 23 miles. *Services*, w. i., lead. *Taps* (in '87), 550. *Meters*, Crown, 12. *Hydrants*, Holly, 75. *Valves*, Chapman.

Consumption, 2,000,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 150 lbs.

Financial.—(In '87.) Cost, $210,000. Bonded debt, $120,000. Int., 6%. Ann. op. exp., $7,200. Ann. rev.: consumers, $18,000; city, $750. Hydrant rental, $60 for 50, $18 for additional.

Management.—Eight Trustees. Chn., Jno. Dougherty. Secy., Geo. A. Shields. Treas., W. L. Graham.

RED CLIFF, *Eagle Co.* (Pop., not given.)

NOTE.—Built by town. No further data can be obtained. Address Mayor.

SALIDA, *Chaffee Co.* (Pop., 2,500; est., 3,500.) In valley of Arkansas river, 8,000 ft. above sea. Engaged in iron, copper and silver mining. Settled and incorp. town in '80. No sewers. Has electric lights.

History.—Built in '82 by town. Engrs. and Contrs., Russell & Alexander, Chicago, Ill., with J. E. Ford in charge.

Water Supply.—South Arkansas river, small mountain stream, by gravity from reservoir. In '89 it was proposed that old reservoir be abandoned and that supply main be extended up-stream 2,800 ft. to new reservoir.

Dam and Reservoir.—Diam., 100 ft. long, of stone and brush, forms reservoir. Wooden flume conveys water 65 ft. to wooden tank, 10 x 20 ft., x 8 ft. deep.

Supply Main.—Is of 6-in. w. i.; leads to town, two miles from and 132 ft. below reservoir.

Distribution.—*Mains*, c. i., w. i., 3 miles, not including supply mains. *Services*, galv. i. *Taps*, 250. *Meters*, none. *Hydrants*, Holly, 20.

Consumption, 300,000 galls. *Pressure*, 56 to 80 lbs.

Financial.—Cost, $25,000. Bonded debt, $24,000. Int., 8%. Sinking fund, $2,250. Ann. op. exp., $600. Ann. rev.: consumers, $2,400.

Management.—Town. Mayor, J. R. Eddy. Chn., J. W. Deen.

SILVER CLIFF, *Custer Co.* (Pop., 5,040; est., 1,500.)

History.—Built in '80, and now owned by Silver Cliff Water Supply Co., city turning works over to bondholders in '86. Works were leased and operated in '88 by Wm. C. Holland, but in early part of '89 they were shut down, and it was not known when they would again be in operation.

Water Supply.—Springs and surface water, pumping to reservoir and direct.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Holly quadruplex.

Reservoir.—No data.

Distribution.—(In '87.) *Mains*, c. i., 8 miles. *Services*, w. i. *Taps*, 300. *Meters*, none. *Hydrants*, Holly, 22. *Valves*, Holly.

Consumption (In '87), 150,000 galls. *Pressure:* Ordinary, 30 lbs. Fire, 70 lbs.

Financial.—(In '87.) Cost, $75,000. Debt and int. not given. Ann. op. exp., $4,000. Ann. rev.: total, $4,000. Town paid Co. $1,200 a year, collecting amounts from those using water for domestic purposes. Co. collects rents from other consumers.

Management.—(In '88.) Prest., Jos. Stanley. Secy., F. C. Young. Lessee, Wm. E. Holland.

SILVERTON, *San Juan Co.* (Pop., 261; est., 2,000.) Engaged in mining and reducing gold and silver ores. Incorp. No sewers or electric lights.

History.—Built in '82-3, and now owned by Silverton Water Supply Co. Built by Silverton Water-Works Co., and sold at auction to its bondholders, who organized as above. Franchise was for 20 years.

Water Supply.—Springs, by gravity from reservoir.

Reservoir.—Cap., 1,000,000 galls.; 120 ft. in diam. at top and 100 ft. at bottom. Inner slope, paved with boulders, covered with 6 ins. of rammed clay. Engr., Jas. H. Mountain. Cost, $12,000.

Distribution.—*Mains*, 5 miles. *Services*, not given. *Taps*, 200. *Meters*, none. *Hydrants*, kind not given, 15.

Consumption, unknown. *Pressure*, 60 lbs.

Financial.—Cost, $50,000. Cap. stock, $50,000. No debt. Ann. op. exp., $1,200. Ann. rev.: consumers, $3,500; city, $2,400.

Management.—Prest., B. L. Carr. Secy. and Treas., F. P. Secor. Both of Longmont. Mgr., H. O. Montague.

SOUTH PUEBLO, *Pueblo Co.* (Pop., 1,446; est., 10,000.) On Arkansas river opposite Pueblo, and now consolidated with it. Has sewers and electric lights.

History.—Built in '81 by Colorado Coal & Iron Co.

Water Supply.—Arkansas river, direct pumping from settling basins.

Pumping Machinery.—Dy. cap., 4,000,000 galls.; Worthington.

Reservoir.—Area, 10 acres.

Distribution.—*Mains*, c. i., 25 miles. *Services*, w. i., lead. *Taps*, 500. *Meters*, none. *Hydrants*, Holly, 90. *Valves*, Chapman.

Consumption, 2,000,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 125 lbs.

Financial.—Cost (in '87), $100,000. No debt. Ann. op. exp., withheld, est., $600. Ann. rev.: consumers (in '87), $9,000; city, $3,000. Hydrant rental, $60 for 50, $48 for additional.

Management.—Supt., G. A. Shields.

TELLURIDE, *San Miguel Co.* (Pop., est., 1,100.) At head of San Miguel river.

History.—Built in '86 by town. Des. Engr., H. Corbin. Const. Engr., — Lader.

Water Supply.—Creek, by gravity.

Reservoir.—Cap., 140,000 galls.; 60 ft. in diam., 7 ft. deep.

Distribution.—*Mains*, 6-in. welded w. i. *Services*, w. i.

Pressure, 180 lbs.

Financial.—Cost, not given, est., $22,000. Bonded debt, $22,000. Int., 8%.

Management.—Supt., F. M. Dunlap. Report by J. P. Rodick.

TRINIDAD, *Las Animas Co.* (Pop., 2,226; est., 7,000.) On Las Animas river, about 6,000 ft. above the sea. Settled in '75; incorp. city in '79. Has electric lights.

History.—Built in '79 by Trinidad Water-Works Co. Engr. and Contr., Delos A. Chappell, Chicago, Ill. Extensive improvements begun in '89, to be completed about May 1, '90; described below, under new works.

Water Supply.—Filter gallery and well near river, pumping to reservoir. To be abandoned after completion of new works.

Filter Gallery and Well.—Gallery is 2 x 3 ft., x 300 ft. long, with dry stone walls covered with flat stone. Well is 25 ft. in diam., 16 ft. deep. Both are in coarse gravel.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; double-acting Cope & Maxwell. A 1,500,000 Gordon & Maxwell is reported as built in '79.

Force Main.—Is 12 ins. in diam., about 1 mile long, rises 310 ft.

Old Reservoir.—Cap., 500,000 galls. Reservoir reported in '82 had cap. of 2,000,000 galls., was 250 ft. above main street, with bottom covered with concrete overlying puddle, and sides paved with flat stones having cemented joints.

The 500,000-gall. reservoir is on new supply main and will be used in connection with new supply.

Distribution.—(In '87.) *Mains*, c. i., 8 miles. *Services*, w. i., lead. *Taps*, 450. *Meters*, Crown (in '86), 125. *Hydrants*, Chapman, Ludlow, 50. *Valves*, Chapman, Ludlow.

Consumption, 500,000 galls. *Pressure*, 135 lbs.

Financial.—(In '87). Cost $110,000. Cap. stock, $50,000. Bonded debt, $50,000. Int., 7%. Ann. op. exp., about $4,000. Ann. rev.: consumers, $10,000; city, about $4,500. Hydrant rental, $100 for 25, $70 for additional.

Management.—Prest., D. A. Chappell, Chicago, Ill. Secy. and Supt., W. B. Cunningham.

NEW WORKS.

Water Supply.—Purgatoire river, by gravity. Supply taken 11 miles from and 400 ft. above city, conveyed through open ditch to reservoir, thence through mains. Introduced about May 1, '90.

Ditch.—Length, 2½ miles.

Reservoir.—Cap., 16,000,000 galls.; area, 3¾ acres; about 280 x 340 ft.; in excavation about 22 ft. on upper, in embankment about 18 ft. on lower side, being on hill side sloping 2 ft. in 100; 8½ miles from, 300 ft. above, city. Banks of clay, 10 ft. wide on top; inner slopes, 2 to 1 unpaved; outer, 1½ to 1. *Spillway:* in earth, with headgate at point 300 ft. from bank. *Discharge-pipe:* 16-in. Built in '89. Engr., C. M. Perin, Trinidad. Contr., J. R. De Remer, Denver. Cost, $7,000. The original plans provide for a second compartment, same size as above, which it is hoped will be built later on.

Supply Main.—About 8¼ miles long; diam., 16 ins. first mile, 14 ins. second mile, 12 ins. remaining distance. Connects with old reservoir (see above), which is but 5 ft. below new, but water can be conveyed directly from upper reservoir to town.

WALSENBURG, *Huerfano Co.* (Pop., 377; est., 3,000.) In agricultural and grazing region, surrounded by extensive fields of bituminous coal. Incorp. No sewers. Has electric lights.

History.—Built in '88 by Walsenburg Water Co., under exclusive franchise. Supplies Tourist City, a suburb. Engr. and Contr., T. F. Martin.

Water Supply.—Lake Miriam, by gravity. Lake is ½ x 1 mile, 25 ft. deep, 3½ miles from, and 265 ft. above, town.

Distribution.—*Mains*, 8-in. asphalt-coated w. i., 6¾ miles. Pipe and specials from National Tube Works Co., McKeesport, Pa. *Services*, ½-in. galv. i. *Taps*, 160. *Meters*, none. *Hydrants*, Ludlow, 16. *Valves*, Ludlow.

Consumption, unknown. *Pressure:* Ordinary, 80 lbs. Fire, 115 lbs.

Financial.—Cost, $70,000. Cap., stock, $75,000. Bonded debt, $30,000. Int., 8%. Ann. sinking fund, $1,500. Ann. op. exp., $400. Ann. rev.: consumers, $3,400; city, $3,200. Hydrant rental, $60.

Management.—Prest., Fred Walsen. Secy. and Treas., T. F. Martin. Supt., F. O. Roof.

WEST DENVER, *Arapahoe Co.* See Barnum and Villa Park.

Water-Works Projected with Fair Prospects of Construction.

DEL NORTE, *Rio Grande Co.* (Pop., 729; est., 1,000.) Near Rio Grande river.

Proposed Works.—July, '89, it was proposed to supply town from irrigating ditch leading from point on Rio Grande river, 14 miles above, to town. T. F. Henry, Denver, was interested. Oct., '89, unofficially reported that town had let contract for artesian well, and that work was in progress.

LITTLETON, *Arapahoe Co.* (Pop., 100; est., 300.) Is 11 miles from Denver.

Proposed Works.—Mains of Citizens' Water Co., of Denver, will run through village, and will probably supply it. Report, about Mar. 20, '90.

LOOKOUT, (*Denver P. O.*) *Arapahoe Co.* (Pop., est., summer, 3,000.)

Proposed Works.—Lookout Water Supply Co. to build in '90, to supply this summer resort; has contract with Golden (nature not stated) by which latter pays $5,000 a year. Surveys being made. Est cost, $100,000; to be met by bonds. Chf. Engr., Jno. S. Titcomb. Prest., Riddle Reeves. Secy., F. G. Patterson. Offices, 7 Tabor Block, Denver. Report, Mar. 13, '90.

NEW CASTLE, *Garfield Co.* (Pop., est., 400). Is 12 miles from Glenwood Springs.

Proposed Works.—Bids opened March 24 for construction, works to be owned by city. Supply, Elk creek or mountain spring [probably] by gravity. Est. cost $15,000; to be met by bonds. Unofficially reported in April, '90, that contract had been let and works would be completed about July 1. Engr. in charge of surveys, W. H. Trumpor. Town Recorder, A. Bondurant, Jr.

SPRINGFIELD, *Baca Co.* (Pop., est., 500.)

Proposed Works.—Village voted bonds in '89 to build works costing about $5,000. Construction was to begin Nov. 15, '89, and be completed Mar. 1, '90. Supply, artesian wells. Address L. A. Anderson or G. H. McIntire. Report, Oct. 12, '90.

WEST COLFAX, (*P. O. probably Denver or W. Denver*) *Arapahoe Co.* (Pop., not given.) Suburb of Denver.

Proposed Works.—Unofficially reported Mar. '90, as follows: W. Colfax Improvement Assn. has contracted with Mountain Water Co. (see Barnum and Villa Park) to lay 8 and 6-in. mains, set 4 hydrants to mile, and furnish water for 5 years for a total rental of $7,800. Officers: Prest., Gov. Loveland. Secy., H. E. Pack. Chf. Engr., F. P. Arbuckle, Denver.

Water-Works Projects Reported in '89 and 90, but Now Indefinite.

Erie. Weld Co. *Granada*, Prowers Co. *Sopris*, Las Animas Co.

NEW MEXICO.

Water-Works Completed or in Process of Construction.

ALBUQUERQUE, *Bernalillo Co.* (Pop., 2,315; est., 8,000.) On Rio Grande river, in mining region. Has electric lights.

History.—Built in '86 by Albuquerque Water Co., under 20-years franchise. No Engr. employed.

Water Supply.—Surface and driven wells, pumping to reservoir. Surface well is 20 ft. in diam., 25 ft. deep, and there are 52 driven wells, each 3 ins. in diam., 40 ft. deep.

Pumping Machinery.—Dy. cap., 3,000,000 galls., Gaskill horizontal, comp., cond.

Reservoir.—Cap., 3,500,000 galls.

Distribution.—(In '87.) *Mains*, kal. l., 7½ miles. *Services*, galv. i. *Taps*, 160. *Meters*, 1. *Hydrants*, Ludlow, 62. *Valves*, Ludlow.

Consumption, 160,000 galls. *Pressure*, 90 lbs.

Financial.—(In '87.) Cost, $118,000. Cap. stock, $110,000. Bonded debt, $110,000. Int., 7%. Ann. op. exp., $5,000. Ann. rev.: consumers, $6,000; city, $5,030. Hydrant rental, $85 for 50, and $65 for extensions, 10 hydrants to the mile.

Management.—(In '88.) Prest., A. A. Grant. Supt., C. J. Stetson.

NOTE.—No report for '89 could be obtained.

CLAYTON, *Colfax Co.* (Pop., not given.)

History.—Built in '88 (probably) by Denver, Texas & Forth Worth R. R.

Water Supply.—Spring, pumping to tank; space about spring excavated 120 ft. in diam. Water flows to pump-well of 16,000 galls. cap.

Pumping Machinery.—Dy. cap., not given; Knowles dup.

Force Main.—Length 2 miles.

Tank.—Cap., 60,000 galls.; 186 ft. above town.

Consumption, about 20,000 galls.

Management.—Pumpg. Engr., H. S. Simpson.

NOTE.—No furter data.

LAS VEGAS, *San Miguel Co.* (Pop., 6,000; est., 10 000.) On Gallinas river. Engaged in stock-raising and mining. Settled in '44; incorp. city in '82. No sewers. Has electric lights.

History.—Built in '81-2 by Aqua Pura Co., under 50-years franchise. Engrs. and Contrs., Russell & Alexander, Chicago, Ill.

Water Supply.—Gallinas river, filtered, by gravity.

Dam.—Impounds stream; of timber, stone and clay; 6 miles from and 350 ft. above city.

Filter and Settling Reservoir.—Water first passes through crib on shore, 6 ft. wide, filled with stone and sand, thence to well, from which 100 ft. of 12-in. pipe leads to settling reservoir in 6 compartments, 25 by 100 ft.

Supply Main.—C. i., 10 and 8-in.

Distribution.—*Mains*, c. i., 14 miles. *Services*, w. i. *Taps*, 698. *Meters*, 1. *Hydrants*, Holly, 34. *Valves*, Ludlow.

Consumption, unknown. *Pressure:* 120 lbs.

Financial.—Cost, $160,000. Cap. stock, $145,000. Bonded debt, $120,000. Int., 6%. Ann. op. exp., $4,000. Ann. rev.: consumers, $16,000; city, $2,700. Hydrant rental, $66.

Management.—Prest., W. A. Vincent. Secy. and Supt., F. H. Pierce.

RATON, *Colfax Co.* (Pop., 2,500; est., 1,800.) On a plain. Has coal mines and railway machine shops. Settled about '79.

History.—Built in '80-1 by A., T. & S. F. R. R. Co., and known locally as Raton Water Co. Des. Engr., A. A. Robinson, Topeka, Kan. Const. Engr., S. M. Rowe, Albuquerque. Material furnished and labor done by Co.

Water Supply.—Springs and well, by gravity from former and by pumping to reservoir from latter. Springs, 20 in all, are 3¼ miles from and 1,200 ft. above town, and water is conveyed from them to town through 2-in. pipe, over very broken ground. Well is one mile from town, on bank of Raton creek. Gravity and pumping systems are connected; latter not run continuously.

Pumping Machinery.—Dy. cap., 230,000 galls.; two Knowles, dup. *Boilers:* two, horizontal, tubular.

Force Main.—Of 8-in. c. i., 8,000 ft. long.

Reservoirs.—Cap., 75,000 galls.; 40 ft. sq. at surface, 10 ft. deep; on high ground.

Distribution.—(In '87.) *Mains*, c. i., 9½ miles, including supply and force mains. *Services*, w. i. *Taps*, 150. *Meters*, 1. *Hydrants*, Holly, 10.

Consumption, 230,000 galls. *Pressure*, 60 lbs.

Financial.—Cost, $54,000. No debt. Ann. op. exp., about $3,500. Ann. rev.: total, $4,000. Hydrant rental is paid by subscription, $100 each for 4.

Management.—Treas., E. Wilder, Topeka, Kans. Supt., Chas. Dyer.

SANTA FE, *Santa Fe Co.* (Pop., 6,535; est., 7,000.) On Santa Fe river, 7,044 ft. above sea. Old Spanish settlement.

History.—Built in '81-3 by Water and Improvement Co., without Contrs. Des. Engr., Thos J. Whitman, St. Louis, Mo. Const. Engr., Jos. E. Barbour.

Water Supply.—Santa Fe river, by gravity from impounding reservoir.

Dam and Impounding Reservoir.—Cap., 30,000,000 galls.; 3½ miles from and 345 ft. above town. Dam of stone masonry, 45 ft. thick at base and 10 at top. It is stated that second reservoir was built in '83.

Supply Main.—Originally 10-in.

Distribution.—(In '87.) *Mains*, c. i., about 10 miles. *Services*, galv. i. *Taps* and *Meters*, not given. *Hydrants*, 25.

Consumption, unknown. *Pressure*, 175 lbs.

Financial.—(In '87.) Cost to '83, $175,000. Cap. stock, $180,000. Bonded debt, $111,000. Int., 6%. Ann. op. exp., $6,000. Ann. rev.: consumers, withheld, est., $10,000; city, $2,500. Hydrant rental, $100.

Management.—(In '88.) Prest. and Treas., Robt. E. Carr, St. Louis, Mo. Supt. and Secy., E. B. Seward.

NOTE.—No report could be obtained for '89.

SILVER CITY, *Grant Co.* (Pop., 1,800; est., 3,000.) Has mining industries.

History.—Built in '86-7 by Silver City Water Co., under 50-years franchise. Des. Engr., W. S. Waring, Const. Engr., F. M. Iler. Contrs., Russell & Alexander, Chicago, Ill.

Water Supply.—Wells, 60 ft. deep, pumping to reservoir and direct.

Tunnel.—Is 4 x 6 ft. x 335 long.

Reservoir.—Cap., 250,000 galls.; 60 ft. square x 9 ft. deep; 225 ft. above town; in rock excavation on top of hill 225 ft. above city. Walled with 2 ft. of stone and cem.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Knowles comp., cond.

Distribution.—*Mains*, 12-in. lap-welded w. i., 8 miles. *Services*, ¾ to 1½-in. black, galv., and kal. i. Pipe and specials from National Tube Works, Chicago, Ill. *Taps*, 200. *Meters*, Crown, 15. *Hydrants*, Ludlow, 25. *Valves*, Ludlow.

Consumption, 60,000 galls. *Pressure*, 100 lbs.

Financial.—Cost, $90,000. Bonded debt, $75,000. Int., 5%. Ann. op. exp., $3,160. Ann. rev.: consumers, $6,000; city, $3,625. Hydrant rental, $150 for first 20, $125 for additional.

Management.—Prest. and Supt., G. H. Utter. Secy. and Treas., Henry Foster.

SOCORRO, *Socorro Co.* (Pop., 1,272; est., 4,100.) On Rio Grando river.

History.—Built in '87 by city. Engr. and Contr., Geo. F. Woolston, N. Y. City.

Water Supply.—Large mountain springs, by gravity.

Distribution.—(In '88.) *Mains*, kal. i., 5½ miles. *Services*, iron. *Taps* and *Meters*, not given. *Hydrants*, Ludlow, 25. *Valves*, Ludlow.

Consumption, 200,000 galls. *Pressure*, 65 lbs.

Financial.—(In '88.) Cost, $30,000. Bonded debt, $30,000. Int. 6%. Ann. op. exp. $1,500. Revenues: not given.

Management.—Water Com. appointed by Council. Report by George F. Woolston.

NOTE.—No report for '89 could be obtained.

SPRINGER, *Colfax Co.* (Pop., 34; est., 750.)

General Description.—Aqua Crystallina Co. began construction in '88. About July 1, '89, reservoir had been built, pump and boiler bought, well and pump-house were ready, and Co. owned 70 lots of land. About $4,000 was needed to complete works. Prest., M. W. Mills. Secy., Henry Sturges. Treas., E. Clouthier Supt., W. W. Jacobs.

GROUP 8.—PACIFIC STATES.—Water-Works Completed, in Process of Construction or Projected, in Washington, Oregon, California Arizona, Nevada, Utah and Idaho.

WASHINGTON.

Water-Works Completed or in Process of Construction.

ANACORTES, *Skagit Co.* (Pop., est., 3,000.) On Puget Sound, on ground sloping up gradually from beach.

General Description.—Anacortes Water Co. to complete May 1, '90. Des. Engr., Benzette Williams, Chicago, Ill. Const. Engr., J. Cryderman. Contr. for labor, Oregon Improvement Co. Supply, springs, by gravity to and from reservoir, 78 ft. in diam., 16 ft. deep, 210 ft. above tide. *Mains*, steel, about 3.6 miles; 9,600 ft. 12, 3,000 ft. 8, 6,600 ft. 6-in. *Hydrants*, 10. Cost, $50,000. Prest., F. A. Hill. Supt., L. C. Roberts. Report by Ira C. Otis; date, Mar. 28, '90.

BELLINGHAM BAY, *Whatcom Co.* (Pop., not given.)

General Description.—Built in '89-90 to supply Bellingham Bay, Sehome and Whatcom; construction begun July, '89, and was to be completed early in '90. Supply, Whatcom lake, by gravity. Lake about 3½ miles from, 317 ft. above, town. Est., cost, $100,000 to $120,000. Prest., Edw. Eldridge. Gen. Supt., P. B. Cornwall. Principal report, Oct. 21, '89.

CHEHALIS, *Lewis Co.* (Pop., est., 1,200.) On Chehalis river.

General Description.—Under construction in '89 by Chehalis Flume & Aqueduct Co. Supply, source not given, by gravity through flume. Est., cost, $15,000. Prest., Wm. West. Secy., N. B. Coffman. Treas., L. Lawrence. Report, Aug. 19, '89.

NOTE.—Works reported in '88 MANUAL as under construction by Chehalis Water Co. were not built, and the project has been abandoned.

COUPEVILLE, *Island Co.* (Pop., est., 250.)

History.—Built in '89 by Coupeville Water Co., put in operation in Dec. Also supplies water for irrigation. Engr., Joseph Goodwin. Contrs., Goodwin & Morrison.

Water Supply.—Spring, pumping to tank and direct. No filtration.

Pumping Machinery.—No data.

Tank.—Cap., 35,000 galls.; 115 ft. above pump.

Distribution.—*Mains*, 3-in. wood, 1½ miles. *Taps*, 25. No hydrants.

Consumption, 2,000 galls.

Financial.—Cost, $5,000. Cap. stock, authorized and paid up, $4,000. No debt. Ann. op. exp., est., $300.

Management.—Prest., M. G. Gaston. Secy., Theo. Cranny. Treas., J. Goodwin. Report, Feb. 13, '90.

ELLENSBURGH, *Kittitas Co.* (Pop., est., 2,200.) On upper Takima river. Incorp. town. No sewers. Has electric lights.

History.—Built in '88 by Capital Hill Water Co. Engr. and Contr., Jno. Corkish, Portland, Ore.

Water Supply.—Wilson creek, by gravity to reservoir. Creek rises in snow-levels of Cascade Mts.

Reservoir.—Cap., 500,000 galls.

Distribution.—*Mains*, wood, 3½ miles. *Services*, galv. i. *Taps*, 200. *Meters*, none. *Hydrants*, Portland, 8. *Valves*, Chapman.

Consumption, 200,000 galls. *Pressure*, 45 lbs.

Financial.—Cost, $50,000. Cap. stock, $50,000. No debt. Hydrant rental, $75.

Management.—Prest., C. A. Sanders. Secy. and Supt., B. E. Craig.

FAIRHAVEN, *Whatcom Co.* (Pop., est., 2,000.) Not incorp. No sewers; electric lights.

History.—Built in '90 by Fairhaven City Water & Power Co.; to be in operation about May 15. Engr., Jno. O'Connor. Contrs., Jno. Barrett Co.

Water Supply.—Lake Padden, by gravity. Lake 400 ft. above sea, 2 miles distant, 30 to 100 ft. deep; area, 1 sq. mile.

Distribution.—*Mains*, 12 to 4-in. c. i., kal. i., 7 miles; from National Tube Works Co., McKeesport, Pa. *Hydrants*, Chapman, 20.

Pressure: Ordinary, 60 to 90 lbs. Fire, about 200 lbs.

Financial.—Cost, est., $60,000. Cap. stock, authorized, $100,000; paid up, $60,000. No bonds.

Management.—Prest., Jas. F. Wardner. Secy. and Treas., Geo. A. Black. Supt., F. N. Gillette. Report, Feb. 14, '90.

KENT, *King Co.* (Pop., est., 500.)

General Description.—Built in '89 by Kent Water Supply Co. Supply, spring, by gravity. Cost, est., $10,000. Prest., J. J. Crow. Secy. and Treas., C. E. Guiberson.

NOTE.—Above subject to correction.

LA CONNER, *Skagit Co.* (Pop., est., 500.) On Puget Sound. Incorp. town.

History.—Built in '88 by La Conner Water-Works Co.; put in operation in June. Des. Engr., H. J. McBride. Const. Engr., H. Orchard.

Water Supply.—Spring, pumping from receiving to distributing tank.

Pumping Machinery.—Dy. cap., 25,000 galls.; two, a steam and windmill.

Tanks.—Cap., 21,000 galls.; one 12 x 16 x 10 ft., one 10 x 12 x 8 ft.

Distribution.—*Mains*, 3-in. wood, about 3 miles; from H. Orchard. *Services*, ½ to 1-in. iron. *Taps*, 60.

Consumption, 3,000 galls.

Financial.—Cost, about $6,000. Cap. stock, authorized, $6,000. No debt. Ann. op. exp., $300. Ann. rev.: consumers, $1,200.

Management.—Prest., G. V. Calhoun. Secy., L. L. Andrews. Treas., W. E. Schricker. Supt., Jno. S. Church. Report, Feb. 13, '90.

NORTH YAKIMA, *Yakima Co.* (Pop., est., 3,000.) Incorp. city. Sewers under construction in '90. Has electric lights.

History.—Built in '90 by Yakima Water Co., under 25-years franchise; to be in operation July 15. Engrs., I. W. Smith and Philip Buehner. Labor done by Co.

Water Supply.—Natchez river, by gravity, with direct pumping to increase pressure, when necessary. No filters.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two 1,500,000 Holly water power. *Water-wheels:* turbines.

Distribution.—*Mains*, 14 to 4-in. c. i., 6½ miles; from Oregon Iron & Steel Co., Portland. *Services*, 2 to ¾-in. *Hydants*, Mathews, 30. *Valves*, Eddy. *Pressure:* Ordinary, 40 lbs. Fire, 120 lbs.

Financial.—Cost, $150,000. Cap. stock, authorized, $150,000. No debt. No bonds authorized. Hydrant rental, $3,000 for all, or $100 each.

Management.—Prest., Edw. Whitman. Secy. and Supt., F. S. Woodward. Report Apr. 30, '90.

OLYMPIA, *Thurston Co.* (Pop., 1,232; est., 3,000.) On Puget Sound in timber country. Engaged in manufacturing and trade. Settled in '48; incorp. town in '61. Has electric lights.

History.—Built in '66 by Olympia Water Co., under 50-years franchise. Engr., W. N. Horton.

Water Supply.—Morley creek and Ferguson springs, pumping to reservoir.

Pumping Machinery.—Dy. cap., 3,600,000 galls.; one 3,000,000 Dow built in '85, and one Hooker.

Reservoir.—Cap., 500,000 galls. In '84 a 3,000,000-gall. reservoir was reported with elevation of 190 ft. above pumps.

Distribution.—(In '87.) *Mains*, Horton wood, 14 miles; prior to '78 mains were ordinary bored logs. *Services*, galv. i. *Taps*, 200. *Meters*, none. *Hydrants*, not given.

Consumption, 200,000 galls. *Pressure*, 60 lbs.

Financial.—(In '87.) Cost, $30,000. Cap. stock, $20,000. Bonded debt, $10,000. Int., 10%. Ann. op. exp., $2,400. Ann rev.: consumers, $5,000; city, not given.

Management.—Secy., E. S. Horton.

NOTE.—No report could be obtained in '89, owing to changes in progress. Unofficially reported Feb., '90, that Co. had sold out to E. W. Andrews, Cincinnati, F. W. Newell, St. Paul, E. L. Sawyer, Tacoma. Also reported that cap. stock would be increased to $100,000, and improvements made.

PALOUSE, *Whitman Co.* (Pop., est., 1,000.) Incorp. village in '88. No sewers or electric lights.

History.—Built in '88 by village, under direction of Trustees. Engr. and Contr., Jno. Corkish, Portland, Ore.

Water Supply.—Palouse river, pumping to reservoir.

Pumping Machinery.—Dy. cap., 600,000 galls.; Blake.

Reservoir.—Cap., 120,000 galls.

Distribution.—*Mains*, kal. i., wood, 2 miles. *Services*, not given. *Taps*, 43. *Meters*, none. *Hydrants*, Chapman, 8. *Valves*, Chapman.

Consumption, 10,000 galls. *Pressure:* Ordinary, 80 lbs. Fire, 100 lbs.

Financial.—Cost $9,000. Debt, $5,593: bonds, $4,800; floating, $793. Int., 7½%. Ann. op. exp., about $1,000. Ann. rev.: consumers, not determined, est., $1,000.

Management.—Trustees. Secy. and Supt., F. M. Martin.

POMEROY, *Garfield Co.* (Pop. est., 1,200.) On Pata ha creek. Incorp. city. Partially sewered. No electric lights.

History.—Built in '87 by city. Engr. and Contr., Jno. Abbott, Portland, Ore.

Water Supply.—Pataha creek through mill-race, pumping to reservoir.

Pumping Machinery.—Dy. cap., 250,000 galls.: Dow water-power, at mill.

Reservoir.—Is 30 x 90 ft., x 16 ft. deep.

Distribution.—*Mains*, 4-in. w. i, 2 miles. *Taps*, 50. *Hydrants*, 12. *Valves*, Ludlow.

Consumption, not given. *Pressure:* Ordinary, 75 lbs. Fire, 200 lbs.

Financial.—Cost, $11,000. Debt, $3,000. Int., 10%. Ann. op. exp., withheld, est., $1,000. Ann. rev.: total, withheld, est., $1,500.

Management.—City Clerk, Jno. W. Cox. Report, Oct. 10, '89.

PUYALLUP, *Pierce Co.* (Pop., est., 1,200.)

NOTE.—Puyallup Water & Light Co. furnish limited supply; Prest., E. Meeker; no further data regarding Co. Town proposes to let contracts for new works, Aug. 1, '90. Supply, large spring, 1½ miles distant, pumping to reservoir. Est. cost., $25,000; to be met by bonds. Engrs., C. E. Sears and A. B. Wood, Puyallup. Town Clerk, B. F. Jacobs. Address A. C. Campbell. Report Oct. 15, '89.

ROSLYN, *Kittitas Co.* (Pop., est., 2,000.) Incorp. town. No sewers or electric lights.

History.—Built in '89 by town; put in operation in Nov. Engr., Wm. McKay.

Water Supply.—Mountain stream, by gravity.

Dam and Impounding Reservo.r.—Contr., Geo. A. Rodamish.

Distribution.—*Mains*, iron, 1 mile. *Services*, galv. i. *Taps* (probably faucets), 150. *Hydrants*, 13.

Consumption, 2,000 galls. *Pressure*, 90 lbs.

Financial.—Cost, $8,000. Debt, $4,000. Int., 10%.

Management.—Chn., Chas. Miller.

SEATTLE, *King Co.* (Pop., 3,533; est., 45,000.) On Elliot bay, Puget Sound. Engaged in lumbering, ship-building, manufacturing and coal mining. Incorp. city. Has sewers and electric lights.

CITY'S WORKS.

History.—Built in '84 by Spring Hill Water Co. Des. Engr., H. H. McWilliams. Const. Engr., Jas. A. McWilliams, present Supt. See Note below.

Water Supply.—Lake Washington, 3 miles from city, pumping to reservoir and tank.

Pumping Machinery.—Dy. cap., 4,500,000 galls.; 4 Dow, having cap. of 2,000,000, 1,000,000, 500,000 and 1,000,000 galls,, respectively, in order of time when built, last being added in '89. First two lift water to reservoir, and last two from reservoir to tank.

Spring Hill Reservoir.—Cap., about 4,000,000 galls.; depth, about 15 ft.; mostly excavated in hardpan. Beneath embankments earth removed to hardpan, slightly below natural surface. Banks of earth, rolled and rammed; 17½ ft. high, 20 ft. wide on top; inner slope 2 to 1, puddled, covered with 8-in. coping; puddle of slope connects with heart-wall by horizontal layer slightly above natural surface. Bottom puddled, then covered with 6 ins. of paving. Space above mouth of force main about 40 ft. in diam., paved with concrete. *Heart-wall:* puddle, 1 part clay, 3 gravel and sand; 6 ft. thick, 9 ft. high, on S. E., 15, on S. W. corner, carried 3 ft. below natural surface. *Spillway:* 12-in. overflow, controlled by gate. *Discharge-pipes:* a 16 and 4-in.; surrounded by puddle; gate on each end of one or both. Dam does not leak. Built in '86. Engrs., see History. No Contrs. Cost, $500,000.

Tank.—Cap., 120,000 galls.; at an elevation of 360 ft.

Distribution.—(Jan. 29. '90.) *Mains*, w. i., 32 miles. *Services*, w. i. Specials from Almond & Phillips, Seattle. *Taps*, 1,600. *Meters*, 60. *Hydrants*, 73.

Consumption (in '89), 2,000,000 galls. *Pressure*, 25 to 120 lbs.

Financial.—Cost (Aug. 8, '89), about $450,000. Cap. stock, $200,000. Bonded debt, $50,000. Int., 6%. Ann. op. exp., $24,000. Ann. rev., total withheld, est., $45,000. Hydrant rental, $84.

Management.—Prest., Bailey Gatzert. Mgr., E. Shepard. Supt., Jas. A. McWilliams.

NOTE.—A bargain for sale of plant to city for $352,000 was made in '89, but transfer could not be effected till '90, owing to necessary legislation which must first be secured. City has employed Benzette Williams, Chicago, Ill., as Consult. Engr. for extensive improvements, which, with purchase of works, will probably cost nearly $1,000,000.

UNION WATER CO.

History.—Built in '82; put in operation in July. Engr., Thos. Gowen.

Water Supply.—Springs, by gravity, Lake Union by pumping. Direct filtration.

Reservoirs.—Cap., 130,000 galls.; two of equal cap

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Dow; added in '89. *Boiler:* from P. J. Sullivan, Seattle.

Distribution.—*Mains*, lap-welded w. i., steel, about 20 miles. *Services*, mostly butt-welded. *Taps*, about 400. *Meters*, 3. No hydrants.

Consumption, 200,000 galls. *Pressure*, 215 lbs.

Financial.—Cost, $110,000. Cap. stock, authorized, $120,000, paid up, $92,300. Debt $20,000. Int., 12 to 8%. Ann. op. exp., $7,200. Ann. rev.: consumers, $9,000.

Management.—Prest., David I. Denny. Secy. and Treas., Edgar Bryan. Supt., Frank Maess. Report, Mar. 17, '90.

SEHOME, *Whatcom Co.* See Bellingham Bay.

SPOKANE FALLS, *Spokane Co.* (Pop., 350; est., 16,000.) On Spokane river, which at this point falls about 180 ft. in 2,500. Incorp. Has sewers and electric lights.

History.—Built in '84 by city, and rebuilt in '88-9. Engr., R. A. Jones, who has had charge of works since their inception. Contr. for original and new works, Philip Buehner, Portland, Ore.

Water Supply.—Spokane river, by direct pumping.

Pumping Machinery.—Dy. cap., 10,000,000 galls.; two 750,000 Gaskill, and later two 4,225,000 Gaskill water-power.

Distribution.—*Mains*, kal. i., c. i., 9 miles. *Services*, galv. i. *Taps*, 600. *Meters*, 6. *Hydrants*, Holly, 84.

Consumption, 2,000,000 galls. *Pressure:* Ordinary, 90 lbs. Fire, 150 lbs.

Financial.—Cost, $177,000. Debt, $110,000; $50,000 at 8; $60,000, at 6%. Ann. op. exp., $4,000. Ann. rev.: consumers, $20,000.

Management.—Supt., R. A. Jones

SPRAGUE, *Lincoln Co.* (Pop., est., 2,000.) Has machine shops. Incorp. city. No sewers. Electric lights projected in '89.

History.—Built in '89 by Sprague Water Co., under 25-years franchise; was to be in operation Dec. 1. Engr. and Contr., Jno. Corkish, Portland, Ore.

Water Supply.—Well, pumping to reservoir and direct.

Pumping Machinery.—Dy. cap., 720,000 galls.; Knowles comp., dup.

Reservoir.—Cap., about 100,000 galls.

Distribution.—*Mains*, banded wood, 4 miles. *Services*, galv. i. *Taps*, about 300. *Meters*, none. *Hydrants*, Portland, 25. *Valves*, Crane.

Consumption, 100,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 80 lbs.

Financial.—Cost, $20,000. Cap. stock, $25,000. No debt. Hydrant rental, $72.

Management.—Prest., Geo. S. Brooke. Secy., W. P. Lottman. Treas., First National Bank. Report, Oct. 22, '89.

SUMNER, *Pierce Co* (Pop., est., 700.) Not incorp. No sewers or electric lights.

History.—Built in '87 by Spring Branch Water Co.; put in operation in Aug. No Engr. Contr., John Corkish, Portland, Ore.

Water Supply.—Springs by gravity to and from reservoir.

Reservoir.—Cap., 100,000 galls.

Distribution.—*Mains*, 12 to 4-in. wood, 3 miles. No *Meters*. *Hydrants*, Portland, 3. *Valves*, Kennedy.

Pressure, 70 lbs.

Financial.—Cost, $6,000. Cap. stock, $10,000.

Management.—Prest., W. L. Thompson. Secy., Treas. and Supt., G. O. Appleby.

TACOMA, *Pierce Co.* (Pop., 1,098; est., 30,000.) On Puget Sound. Engaged in manufacturing and trade. Incorp. city. Has sewers and electric lights.

History.—Built in '85 by Tacoma Light and Water Co. Engr., Isaac W. Smith, Portland, Ore. Extensions to cost $500,000 to $750,000, projected for '90.

Water Supply.—Spanaway lake and Clover creek, 10 miles from city, by gravity to and from reservoir for low, and springs by pumping for high service.

Conduit.—To reservoir; about 10 miles long; no further data.

Reservoir.—Cap., 1,750,000 galls.; in southwestern part of city about 260 ft. above low tide. A 12-in. pipe leads from reservoir to low service.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; Gaskill water-power, driven by Leffel turbine, and one dup. water-motor. Pump is in canyon 185 below, and 1,900 from reservoir. Turbine is driven by water brought from springs in w. i. pipe, under 85 ft. head. Pump forces water to elevations 380 ft. above sound.

Distribution.—*Mains*, c. i., 16 miles. *Services*, galv i. *Taps* (Aug., '89), 1,350. *Meters*, 35. *Hydrants*, Mathews, 50.

Consumption, 2,000,000 galls. *Pressure*, 78 lbs.

Financial.—Cost, $300,000. Debt and int., not given. Ann. op. exp., not given; est., $5,000. Ann. rev.: consumers, $50,000; city, $3,500. Hydrant rental, $60.

Management.—Prest., Theo. Hosmer. Secy. and Treas., J. H. Houghton. Supt., Chas. B. Hurley.

VANCOUVER, *Clarke Co.* (Pop., 1,722; est., 3,000, and 1,000 additional at Vancouver Barracks.) On Columbia river. Settled in '50; incorp. city in '68. No sewers. Has electric lights.

History.—Built in '68 by private Co., name not given, under 25-years exclusive franchise. Des. Engrs., Augusta Shaben and Lewis Meyers. Water is furnished to Vancouver Barracks.

Water Supply.—Springs, about 4 miles distant, by gravity from impounding to distributing reservoirs.

Dam and Impounding Reservoir.—Cap., 500,000 galls.; dam 100 ft. long, 7 ft. high; of timber; built across ravine.

Conduit.—Wood, 5½-in., 3¾ miles long. Not stated whether still in use.

Flume.—Dy. cap., 150,000 galls.; 12 ins. sq.; in sections 16 ft. long, with ⅜-in. fall per section. Built in '89 from springs to distributing reservoirs. Cost, $14,000.

Distributing Reservoirs.—Cap., 30,000 and 500,000 galls. respectively; brick, near and 90 ft. above city.

Distribution.—*Mains*, c. i., wood, 13½ miles. *Services*, galv. i. *Taps*, 350. *Meters*, 1. *Hydrants* (in '87), 10 at Barracks, kind not given.

Consumption (in '87), 150,000 galls. *Pressure*, fire, 75 lbs.

Financial.—Cost, est., $89,000. No debt. Ann. op. exp., $2,000. Ann. rev.: consumers, $6,600; Barracks, $4,800.

Management.—Prest., S. W. Brown. Secy., G. H. Steward, Supt., J. R. Wintler.

WALLA WALLA, *Walla Walla Co.* (Pop., 3,558; est., 5,000.) On Milk creek, nearly surrounded by Blue Mts. Settled in '57; incorp. in '62. Has electric lights.

History.—Built in '65 by Walla Walla Water Co.

Water Supply.—Springs, by gravity from collecting reservoirs.

Reservoirs.—Cap., about 1,500,000 galls., and 400,000 galls., respectively; first is 100 x 250 and second 75 x 130 ft., each 7 ft. deep.

Distribution.—(In '87.) *Mains*, kal, i., 14 miles. *Services*, w. i. *Taps*, 500. *Meters*, none. *Hydrants*, made at Walla Walla, 25. *Valves*, Eddy.

Consumption 600,000 galls. *Pressure*, 38½ lbs.

Financial.—(In '87.) Cost, $125,000. Cap. stock, $100,000. Bonded debt, $50,000. Int., 8%. Ann. op. exp., withheld, est., $3,000. Ann. rev.: total, withheld, est., $15,000.

Management.—(In '88.) Prest., R. R Rees. Supt., Jerome F. Bowman.

NOTE.—No report for '89 could be obtained.

WEST SEATTLE, *King Co.* (Pop., est., 400.)

General Description.—Built in '89 by West Seattle Land & Improvement Co., for domestic supply; completed prior to Oct., '89. Supply, springs, pumping to tank. Cost, $25,000. Prest., Thos. Ewing. Secy., M. S. Bates. Report, Oct. 27, '90.

WHATCOM, *Whatcom Co.* (Pop., est., 2,400.) See Bellingham.

Water-Works Projected With Fair Prospects of Construction.

ABERDEEN, *Chehalis Co.* (Pop., est., 1,800.) On Chehalis river, in lumber district.

Proposed Works.—Aberdeen Water Co. to complete in '90. Supply, creek, pumping to tank. Est. cost., $25,000. Prest., C. B. Weatherwax. Secy., Geo. D. Allen. Latest report, Feb. 14, '90.

ASOTIN, *Asotin Co.* (Pop., est., 300.) On Snake river. Has water-power.

Proposed Works.—Address Geo. W. Bailey. See MANUAL for '88, p. 506.

CENTRALIA, *Lewis Co.* (Pop., est. 3,000.) Incorp. town. No sewers or electric lights.

Proposed Works.—A. J. Miller to build in '90. Supply, pumping to reservoir. Report by Landrum & Landrum; date, Feb. 12, '90.

CHENEY, *Spokane Co.* (Pop., est., 900.)

Proposed Works.—Two or three Cos. were incorp. to build here in '89. Unofficially reported, Apr., '90, that pipe-laying was in progress. No definite data can be obtained.

COLFAX, *Whitman Co.* (Pop., 444; est., 1,200.) Has manufactories and electric lights.

Proposed Works.—Under consideration in '89. Address H. W. Livingston or village clerk.

COLVILLE, *Stevens Co.* (Pop., est., 500.)

Proposed Works.—Dec. 10, '89, town granted franchise to Spring Mountain Water Co., under condition that $5,000 be expended within 8 months. Supply, Spring brook, 5 miles N. E. of town, by gravity. Est. cost, $15,000. Prest., John B. Slater. V. Prest., J. M. Buckley, Spokane Falls. Secy, and Engr., E. J. Roberts. Treas., J. H. Young. Report, Feb. 19, '90.

MONTESANO, *Chehalis Co.* (Pop., est., 500.) At head of navigation on Chehalis river. Has electric lights.

Proposed Works.—Under discussion in '90. Supply, Sylvia creek, pumping to small tank and repumping from 6-in. supply main for high service. Windmill pump to lift water from creek, and steam pump from supply main. Clerk, A. E. Griffith.

MOUNT VERNON, *Skagit Co.* (Pop., est., 1,500.) On Skagit river.

Proposed Works.—Mount Vernon Spring Water Co., to build in '90. Supply, springs. Est. cost, $3,000. Prest., B. W. Williams. Secy., Geo. M. Sinclair. Report, Oct. 24, '89.

PORT TOWNSEND, *Jefferson Co.* (Pop., est., 6,000.) On Port Townsend bay. Engaged in lumber industries and trade.

Proposed Works.—Mount Olympus Water Co. to begin construction July 1, '90. Preliminary surveys being made by R. E. Andrews. Supply, Quilcene river, 18 miles distant, by gravity to and from 7,500,000-gall. reservoir near and about 175 ft. above city. Cap. stock, $500,000. Prest., A. W. Bash. Latest report, Feb. 13, '90.

PULLMAN, *Whitman Co.* (Pop., est., 600.)

Proposed Works.—Town to build in '90. Supply, artesian wells, by gravity to and from reservoir. Est. cost, $10,000; enabling act to issue bonds not secured. Report by Thos. Neill; date Jan. 28, '90.

WAITSBURGH, *Walla Walla Co.* (Pop., est., 1,000.)

Proposed Works.—City wishes to build, and is trying to secure necessary enabling act from legislature, it now being limited to a debt of 1% of assessed valuation. Supply, Touchet river or wells, probably pumping to reservoir. Est. cost, $15,000 to $20,000. City Clerk, Richard H. Ormsbee. Latest report, about Mar. 10, '90.

Water-Works Projects Reported in '89 and '90, but Now Indefinite.

Uniontown, Whitman Co. *Wallula,* Walla Walla Co.; see MANUAL for 88, p. 507.

OREGON.

Water-Works Completed or In Process of Construction.

ALBANY, *Linn Co.* (Pop., 1,867; est., 2,500.) At junction of Willamette and Callapooya rivers. Has manufactories. Incorp. Partially sewered. Has electric lights.

History.—Built in '80 by J. A. Crawford.

Water Supply.—Santiam canal and Calapooya river, by direct pumping.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two 1,000,000 Dow water-power, built in '89.

Distribution.—*Mains*, c. i., 3.6 miles. *Services*, galv. i., black i. *Taps*, 200. *Meters*, none. *Hydrants*, 5.

Consumption, 600,000 galls. *Pressure*, 40 to 50 lbs.

Financial.—Cost, $15,000. Debt and int., not given. Ann. op. exp., "no expense account kept." Ann. rev.: consumers, about $3,000; city, $100. Hydrant rental, $33.

Management. Owner. J. A. Crawford. Secy. and Supt., L. E. Gray.

ALBINA, *Multnomah Co.* (Pop., est., 3,000.) On Willamette river, opposite Portland.

General Description.—About July 10, '89, G. W. Good, Portland, stated that Albina Water Co. would complete works Aug. 1, '89. Supply, driven wells, pumping to 150,000-gall. tank. Cost, $25,000. Prest., G. W. Good, Portland. Later (unofficial) reports stated that both the East Portland Water Co. and G. W. Bates claimed to have bought the works.

ARLINGTON, *Gilliam Co* (Pop., est, 1,000.) Incorp. town. No sewers or electric lights.

History.—Built in '88 by Arlington Water Co. Engr. and Contr., Jno. Corkish, Portland, Ore.

Water Supply.—Columbia river, pumping to reservoir.

Pumping Machinery.—Dy. cap., 500,000 galls.; Blake dup.

Reservoir.—Cap., 100,000 galls.

Distribution.—*Mains*, 6 and 8-in., wood, 2 miles; from Puget Sound Pipe Co., Olympia. *Services*, galv. i. *Taps*, 70. *Meters*, none. *Hydrants*, from Union Iron Works, 8. *Valves*, Kennedy.

Consumption, 100,000 galls. *Pressure*, 88 lbs.

Financial.—Cost, $7,000. Cap. stock, $10,000. No bonds. Debt (in '87), $2,000. Int., 10%. Ann. op. exp., $1,200. Ann. rev.: consumers, $3,200; city, $900. Hydrant rental, $60.

Management.—Prest., J. E. Frick. Secy., A. C. Fry. Supt. and Engr., E. D. Parrot.

ASTORIA, *Clatsop Co.* (Pop., 2,803; est., 6,000.) At mouth of Columbia river, on low ground, buildings in business portion being on piles. Has manufactories. Settled in '10. Incorp. village in '52; city in '74. Has electric lights.

History.—Present works built in '83-4 by Columbia Water Co. Des. Engr., D. P. Thompson. Small works were built in '70 and '72, but no information is given regarding them.

Water Supply.—Mountain spring, by gravity. Previous report gives supply as Bear creek, small stream 12 miles east of city, water being impounded in 75,000 and 100,000-gall. reservoirs, about 300 ft. above city.

Reservoir.—Cap., 100,000 galls. See above.

Distribution.—(In '87.) *Mains*, w. i., 13 miles. *Services*, galv. i. *Taps*, not given. *Meters*, 6. *Hydrants*, 1.

Consumption, 300,000 galls. *Pressure*, 45 to 65 lbs.

Financial.—(In '87.) Cost, $80,000. Cap. stock, $100,000. No debt. Ann. op. exp., withheld, est., $2,500. Ann. rev.: total, withheld. est., $10,000.

Management.—(In '88.) Prest., F. DeKum. Supt., Jas. W. Welch.

NOTE.—No report for '89 could be obtained.

BAKER CITY, *Baker Co.* (Pop., est., 3,500.) On south fork of Powder river. Incorp. city. No sewers or electric lights.

History.—Built in '88-9 by city. Contr., J. C. White. Extensive improvements made in '89.

Water Supply.—Artesian wells, pumping to reservoir and direct. There are 6 wells, one 4 ins. others 3 ins. in diam., from 75 to 155 ft. deep. Van Duzen steam syphon on one of 3-in. wells gives steady flow of 6,000 galls. per hour.

Pumping Machinery.—Dy. cap., 750,000 galls.; Worthington comp., dup.
Reservoir.—Cap., 425,000 galls.; in excavation, 150 ft. above city.
Distribution.—*Mains*, 10 to 6-in., 2 miles. *Services*, not given. *Taps*, 75. *Meters*, none. *Hydrants*, 16.
Consumption, 150,000 galls. *Pressure*, 65 lbs.
Financial.—Cost, $20,000. Bonded debt, $20,000. Int., 6%.
Management.—Supt., Wm. O. Reynolds.

COQUILLE, *Coos Co.* (Pop., 176; est., 600.) On Coquille river. Incorp. No sewers or electric lights.
History.—Built in '85-6 by Occident Water Co.
Water Supply.—Mountain stream, by gravity.
Distribution.—*Mains*, 4-in., 2 miles. *Services* and *Taps*, not given. *Meters*, none. *Hydrants*, 4.
Consumption, 2,000 galls. *Pressure*, not given.
Financial.—Cost, $3,000. Cap. stock, $1,600. No debt. Ann. op. exp., $300. Ann. rev.: consumers, $600; city, $100.
Management.—Prest. and Supt., E. B. Miller. Secy., A. J. Sherwood. Treas., J. A. Collier.

CORVALLIS, *Benton Co.* (Pop., 1,128; est., 2,000.) On Willamette river. Not incorp. No sewers. Has electric lights.
History.—Built in '87 by Corvallis Water Co.
Water Supply.—Willamette river, pumping to tank and direct.
Pumping Machinery.—Dy. cap., 500,000 galls.; Worthington.
Tank.—Cap., 15,000 galls.
Distribution.—*Mains*, w. i., 3 miles. *Services*, w. i. *Taps*, 200. *Meters*, 1. *Hydrants*, 9.
Consumption, 200,000 galls. *Pressure:* Ordinary, 23 lbs. Fire, 90 lbs.
Financial.—Cost, $16,000. Cap. stock, $20,000. Debt (in '87), $1,800. Int., 10%. Ann. op. exp., $600. Ann. rev.: consumers, $3,600; city, $550. Hydrant rental, $36.
Management.—Prest., G. R. Farrar. Secy. and Supt., Wm. Graves.

EAST PORTLAND, *Multnomah Co.* (Pop., 2,934; est., 10,000.) On Willamette river, opposite Portland. Incorp. No sewers. Has electric lights.
History.—Built in '81-2 by East Portland Water Co. Engr., W. S. Chapman, Portland. Contrs., H. D. McGuire & W. S. Chapman, Portland. Sub-contr. for masonry, buildings and tank, J. L. Spore, East Portland.
Water Supply.—Stephens springs, pumping to tank and direct.
Pumping Machinery.—Dy. cap., 3,000,000 galls.; Worthington dup.
Tank.—Cap., 150,000 galls.; 60 x 80 ft.; at elevation of 80 ft.
Distribution.—*Mains*, 6 and 4-in. wood, c. i., 15 miles. *Services*, w. i. Pipe and specials from Jno. Barrett, Portland. *Taps* (in '87), 500. *Meters*, 10. *Hydrants*, from Willamette Iron Works, Portland, 32.
Consumption, 1,500,000 galls. *Pressure:* Ordinary, 80 lbs. Fire, 120 lbs.
Financial.—Cost, $113,000. Cap. stock, $60,000. Debt, $24,000. Int., 9%. Ann. op. exp., $10,000. Ann. rev.: consumers, $15,600. Hydrant rental, about $60.
Management.—Prest., H. P. McGuire. Secy., W. S. Chapman. Treas., W. W. McGuire.

EUGENE CITY, *Lane Co.* (Pop., est., 3,000.) On Willamette river. Incorp. No sewers. Has electric lights.
History.—Built in '86 by Co., under exclusive franchise. Des. Engr., —— Chase, Corvallis. Const. Engr., Jno. Barrett, Portland.
Water Supply.—Willamette river, pumping to reservoir and direct.
Pumping Machinery.—Dy. cap., 1,000,000 galls.; two 500,000 Dow, one built in '88 and one in '89.
Reservoir.—Cap., 250,000 galls.
Distribution.—*Mains*, 8 to 3-in. c. i. and w. i., 12 miles. *Services*, w. i. *Taps* (in '87), 300. *Meters*, none. *Hydrants*, 27.
Consumption, 170,000 galls. *Pressure:* Ordinary, 73 lbs. Fire, 260 lbs.
Financial.—Cost, not given, est., $45,000. Cap. stock, $40,000. No debt. Ann. op. exp., $1,700. Ann. rev.: consumers, not given, est., $10,000; city, $1,000 for all hydrants.
Management.—Prest., T. W. Shelton. Secy., J. F. Robinson. Supt., G. R. Chrisman.

GARDINER, *Douglas Co.* (Pop., 376.)
General Description.—Gardiner Mill Co. control town. Supply, springs on hill, by gravity.

HOOD RIVER, *Wasco Co.* (Pop., 361; est., 200.) At junction of Columbia and Hood rivers. Settled in '82. Not incorp. No sewers or electric lights.
History.—Built in '83 by E. F. & H. C. Coe, under name of Hood River Hydrant Co.
Water Supply.—Spring, 150 ft. above village, by gravity.
Distribution.—*Mains*, 2-in. w. i., 1 mile. *Services*, w. i. *Taps*, 35. *Meters* and *Hyarants*, none.
Consumption, unknown. *Pressure*, 150 ft. head.
Financial.—Cost, $2,000. No debt or op. exp. Ann. rev.: consumers, withheld, est., $600; city, none. Hydrant rental, $18.
Management.—Owners, E. F. & H. C. Coe, latter being Supt.

JOSEPH, *Wallowa Co.* (Pop., est., 1,000.) Engaged in mining and manufacturing. Incorp. town. No sewers or electric lights.
History.—Built in '89 by Joseph Water Co. Const. Engr., S. J. White, La Grande. Labor done by Co.
Water Supply.—Lake, by gravity.
Distribution.—*Mains*, 8 to 4-in. wood, 2 miles; from Puget Sound Pipe Co. Olympia, Wash. *Services*, galv. i. *Taps*, 50. *Meters*, none. *Hydrants*, Portland, 5. *Valves*, Kennedy.
Pressure, 65 lbs.
Financial.—Cost, $5,000.
Management.—Prest., D. F. McCully. Report, July 5, '89.

LA GRANDE, *Union Co.* (Pop., 836; est., 3,000.) Has railway repair shops. Incorp. town. No sewers. Has electric lights.
History.—Built in '87 by La Grande Water Co.; put in operation in Oct. Engr., Danl. Chaplin. Contr., Jno. Corkish, Portland.
Water Supply.—Mill creek, by gravity to reservoir.
Reservoir.—Cap., 500,000 galls.
Distribution.—*Mains*, 12 to 3-in. wood, 4 miles; from Puget Sound Pipe Co. Portland. *Services*, galv. i. *Taps*, 200. *Meters*, none. *Hydrants*, Portland, 10. *Valves*, Chapman.
Consumption, 200,000 galls. *Pressure*, 70 lbs.
Financial.—Cost, $15,000. Cap. stock, $20,000. No debt. Ann. op. exp., not given, est., $750. Ann. rev.: consumers, $4,000; city, $600. Hydrant rental, $60.
Management.—Prest. and Treas., Jno. Corkish, Portland. Secy., Jas. Dwight. Treas., S. J. White. Report, July 5, '89.

McMINNVILLE, *Yam Hill Co.* (Pop., 1,408; est., 1,800.) On Yam Hill river, which is navigable to this point. Incorp. city. No sewers. Has electric lights.
History.—Built in '89 by city; put in operation about Dec. 15. Des. Engr., J. B. Pilchford. Const. Engr., W. F. Toothaker. Contrs., W. T. Garratt & Co., San Francisco, Cal.
Water Supply.—Yam Hill river, pumping direct.
Pumping Machinery.—Dy. cap., 1,300,000 galls.; two 650,000 Hall dup.
Distribution.—*Mains*, spiral-welded steel, 2 miles. *Hydrants*, Garratts, 13.
Pressure: Ordinary, 45 lbs. Fire, 130 lbs.
Financial.—Cost, $20,000. Bonded debt, $20,000. Int., 6%.
Management. Com. Supt., P. D. Glenn. Report by J. J. Spencer; date, Nov. 30, '89.

MEDFORD, *Jackson Co.* (Pop., est., 1,800.) Incorp. Sewers and electric lights projected.
History.—Built in '88-9 by city. Engr., J. S. Howard.
Water Supply.—Bear creek, by gravity through canal and by pumping from canal to reservoir. Canal is 2½ miles long and has dy. cap. of 26,928,000 galls.
Pumping Machinery.—Dy. cap., 240,000 galls.; make not given.
Reservoir.—Cap., 40,000 galls.
Distribution.—(Aug. 1, '89.) *Mains*, 1 mile. *Hydrants*, 7.
Financial.—Cost, $10,000. Bonded debt, $10,000. Int., 6%. Ann. op. exp., est., $200.
Management.—City. Report by S. S. Pentz.

MILTON, *Umatilla Co.* (Pop., est., 900.) Incorp. in '85. No sewers or electric lights

History.—Built in '88 by town. Const. Engr. and Contr., Jno Corkish, Portland.

Water Supply.—Walla Walla river, by gravity.

Distribution.—*Mains*, 12 to 6-in. wood, 1¼ miles; from Puget Sound Pipe Co., Olympia, Wash. *Services*, galv. i., black i. *Taps*, 25. *Meters*, none. *Hydrants*, Holly, 4. *Valves*, Kennedy.

Pressure, 40 lbs.

Financial.—Cost, $5,000. Bonded debt, $5,000. Int., 8%. No. op. exp. Ann. rev.: consumers, $500.

Management.—City Council. Secy., J. L. Elam. Supt., A. Allen.

OREGON CITY, *Clackamas Co.* (Pop., 1,263; est., 2,500.) On Willamette river. Has water-power and manufactories. Incorp. No sewer. Has electric lights.

History.—Built in '86 by town. New system built in '89.

Water Supply.—Willamette river, pumping to stand-pipe and direct.

Pumping Machinery.—Dy. cap., 500,000 galls.; 4 plunger, and one piston pump, driven by water-power; from Willamette Iron Works. In '89 1,500,000 Dow was reported as built.

Stand-Pipe.—No data.

Distribution.—*Mains*, 10 and 8-in. c. i., 2 miles. *Services*, w. i. *Taps*, about 250. *Meters*, none. *Hydrants*, 20.

Consumption, not given. *Pressure:* Ordinary, 75 lbs. Fire, 125 lbs.

Financial.—Cost, $10,000. Debt not given. Ann. op. exp., $800. Ann. rev.: consumers, $3,500.

Management.—Supt., W. H. Howell.

PENDLETON, *Umatilla Co.* (Pop., 949; est., 4,000.) On Umatilla river. Has manufactories. Incorp. Has sewers and electric lights.

History.—Built in '87 by town. Des. Engr., P. F. Morey. Const. Engr., W. A. Sales. Contrs., Saunders & Church, Pendleton.

Water Supply.—Well, pumping to reservoir. Well is in gravel and has branch supply duct on bed rock, 400 ft. long.

Pumping Machinery.—Dy. cap., 1,00,000 galls.; Blake comp., dup. and 250,000 Dow, built in '86.

Reservoir.—Cap., 500,000 galls.; 180 ft. above city.

Distribution.—*Mains*, kal. i., 6½ miles. *Services*, w. i. *Taps*, 400. *Meters*, none. *Hydrants*, Chapman, 21.

Consumption, 500,000 galls. *Pressure*, 80 lbs.

Financial.—Cost, $40,000. Debt, $30,000. Int., 7%. Ann. op. exp., est., $5,500. Ann. rev.: consumers, $6,500.

Management.—Supt., C. E. Roosevelt.

PORTLAND, *Multnomah Co.* (Pop., 17,577; est., 40,000.) On Willamette river, on plateau rising gradually from river bank. Settled in '41: incorp. in '51. Has sewers and electric lights.

History.—Built about '53, and now owned by city. H. Bloomfield, of San Francisco, Cal., was Engr. for improvements made from '68 to '85. Until Jan. 1, '87, works were owned by the Portland Water Co., when they were sold to city for $450,000. Extensive improvements made in '89-90, and others projected.

Water Supply.—Willamette river, by direct pumping. Early supply was by gravity from Balsh and Caruthers creeks, and by pumping from well. In '69 river was drawn upon, but creeks furnished large part of supply as late as '76. It is proposed to secure additional supply from Bull run, by gravity, through w. i. pipes, 32 miles long.

Pumping Machinery.—Dy. cap., 16,500,000 galls.; two 5,000,000 Worthington and one 10,000,000 Gaskill horizontal for low service. one 1,500,000 Gaskill for high service.

First pump used, that at well, had dy. cap. of 300,000 galls. In '69 an 800,000-gall. pump, built by Oregon Iron Co., was placed in station at river, and in '71 this was supplemented by 1,000,000-gall. Worthington. In '76 pumping station now known as round house was built, and new 3,000,000-gall. placed in it and 1,000,000-gall. pump moved from old station, which was then abandoned. In '84 or '85 Palatine station was built, and two 5,000,000-gall. pumps placed. Holly pumps were bought in '88-9.

Reservoir.—Cap., 2,000,000 galls; used for surplus only.

Distribution.—*Mains*, c. i., 33.51 miles. *Services*, galv. i. *Taps*, est., 1,510. *Meters*, Worthington, '80. *Hydrants* (in '90), 197. *Valves*, Chapman.

Consumption, 5,900,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 90 lbs.

Financial.—Cost, $600,000. Bonded debt, $600,000. Int., 5%. Ann. op. exp., $54,792. Int. on bonds, for '88, $25,000 Ann. rev.: consumers, $111,292; city, $2,400.

Management.—Works are construc ed by Water Com. of fifteen. When completed, they will be turned over to Commission of five. Chn., H. Failing. Clerk, P. C. Schuyler. Supt., I. W Smith.

NOTE.—Further details of new works will be given in next MANUAL.

ROSEBURGH, *Douglas Co.* (Pop., 882; est., 2,000.) On Umpqua river. Engaged in milling and mining. Settled in '60; incorp. in '70. No sewers or electric lights.

History.—Built in '89 by Roseburgh Water Co., under 30-years franchise; put in operation Jan. 1, '90. Contrs., Jno. Barrett Co., Portland.

Water Supply.—Umpqua river, pumping direct and to reservoirs.

Pumping Machinery.—Dy. cap., 400,000 galls.; Dow water-power. Worthington steam pump to be added in '90.

Reservoirs.—Cap., 600,000 galls.; two; built by Co.

Distribution.—*Mains*, 8 to 3-in. kal. l., 3½ miles. *Services*, 1 to ¾-in. *Taps*, 100. *Hydrants*, Eclipse, 20.

Consumption, 100,000 galls. *Pressure*, 180 lbs.

Financial.—Cost, $21,000. Cap. stock, authorized and paid up, $20,000. No debt. Ann. op. exp., est., $1,200. Ann. rev.: consumers, est., $2,000; city, $1,000, for all purposes, or $50 per hydrant; 10 years contract.

Management - Prest., T. R. Sheridan. Secy., W. S. Hamilton. Treas., S. C Flint. Supt., O. L. Willis. Latest report, Mar. 6, '90.

SALEM, *Marion Co.* (Pop., 2,538; est., 6,500.) On Willamette river. Engaged in manufacturing. Settled in '40; incorp. in '46. Has sewers and electric lights.

History.—Built in '71 and extended in '83 and '87 by Salem Water Co., under 17-years franchise. J. M. Martin and W. F. Boothby are each accredited as Engr. of works.

Water Supply.—Willamette river, by direct pumping. Tests for a driven well supply were in progress Aug. 22, '90.

Pumping Machinery.—Dy. cap., 7,500,000 galls.; four Dow water-power and one Davis dup. steam.

Filter.—In river at end of suction pipe; built in '89; cost, $3,000.

Distribution.—*Mains*, c. i., w. i., 13 miles. *Services*, galv. i. *Taps*, 975. *Meters*, none. *Hydrants*, 50.

Consumption, 2,000,000 galls. *Pressure:* Ordinary, 55 lbs. Fire, 75 lbs.

Financial.—Cost, $175,000. No debt. Ann. op. exp., $4,500. Ann. rev.: consumers, $12,000; city, $1,000. Hydrant rental, $21.

Management.—Prest., Secy., and Supt., J. M. Martin. Treas., J. H. Albert.

THE DALLES, *Wasco Co.* (Pop., 2,232; est., 5,000.) On Columbia river. Settled in '52; incorp. in '58. Has sewers and electric lights.

History.—Built in '62 by Rebt. Pentland, and now owned by Dalles Mill & Water Co. In '89 city contemplated building works prior to close of '90.

Water Supply.—Hood river, by gravity.

Reservoir.—Cap., 50,000 galls.

Distribution.—*Mains*, c. i., w. i., 11 miles. *Services*, galv. i. *Taps*, 750. *Meters*, none. *Hydrants*, 16.

Consumption, 800,000 galls. *Pressure*, 40 lbs.

Financial.—Cost, $52,000. Cap. stock, $60,000. Debt., $10,000. Ann. op. exp., est., $3,000. Ann. rev.: consumers, est., $12,000; city, $100. Hydrant rental, $100 for 16, or $6.33 each.

Management.—Prest., F. Dekum. Secy., R. G. Durham. Supt., J. H. Phirman. Report by Hugh Logan.

NOTE.—Above description of Water Supply, Reservoir and Distribution is subject to correction. Report for '82 gave source of supply as mountain stream, wing-dam diverting part of flow into box conduit of 1¼-in. fir plank, 8½ x 10 ins., laid underground for 1½ miles to two reservoirs. One of reservoirs was described as of stone, 16 x 18 ft., x 8 ft. deep, and other natural rock basin, 75 x 150 ft., x 12 ft. deep, and 90 ft. above the town.

WESTON, *Umatilla Co.* (Pop., 446; est., 700.) Incorp. No sewers or electric lights.

History.—Built in '89 by town; put in operation Oct. 1. Engr. and Contr., Jno. Corkish, Portland.

Water Supply.—Pine creek, a spring-fed mountain stream, by gravity, Source is two-miles distant.

Reservoir.—Cap., 100,000 galls.

Distribution.—*Mains*, steel-banded wood, 3 miles; from Puget Sound Pipe Co., Olympia, Wash. *Taps*, 75. *Meters*, none. *Hydrants*, Portland, 10. *Valves*, Kennedy.

Consumption, 80,000 galls. *Pressure*, 70 lbs.

Financial.—Cost, $9,500. Bonded debt, $10,000. Int., 10%. Ann. op. exp., est., $300.

Management.—Com. Address, P. A. Worthington. Latest report, Nov. 27, '89.

Water-Works Projected with Fair Prospects of Construction.

ASHLAND, *Jackson Co.* (Pop., 842; est., 2,500.) Manufactures woollen goods, flour and lumber.

Proposed Works.—City wished to build in '89. Unofficially reported, Nov., '89, that contracts had been let for about 11 miles 10 to 2-in., double-riveted, spiral-welded and lap-welded pipe, there being 30,000 ft. of the latter, 2 ins. in diam., from National Tube Works Co., McKeesport, Pa. City Recorder, Milton Berry.

ENTERPRISE, *Wallowa Co.* (Pop , est., 400.)

Proposed Works.—Enterprise Water Co., organized in '89, and hope to build in '89. Pumping to reservoir. Cap. stock, $5,000. Address W. H. Challis or J. M. Church.

GRANT'S PASS, *Josephine Co.* (Pop. est., 2,200.) On Rogue river.

Proposed Works.—Wm. Knox, Haywards, Cal., and F. M. Johnson have organized Grant's Pass Water, Light and Power Co,, and hope to build in '90. Supply, Rogue river, pumping to reservoir 150 ft. above town. Two 50-H. P. engines to run pump and dynamos until dam for water-power is built across river. Est. cost, $30,000. Report, Feb. 26, '90.

HEPPNER, *Morrow Co.* (Pop., est., 1,000.)

Proposed Works.—Town wishes to build, but has done nothing definite. Supply, artesian or driven wells, pumping to tank. Est. cost, $15,000 to $20,000. Report by A. Malloy, date, Feb. 5, '90.

Water-Works Projects Reported in '88 and 89, but now Indefinite.

Fossil, Gilliam Co.

CALIFORNIA.

Water-Works Completed or in Process of Construction.

ALAMEDA and FITCHBURG, *Alameda Co.* (Pop., Alameda, 5,708; est., 10,000.) On San Francisco bay, 8 miles from San Francisco; on level ground surrounded by hills. Settled in '56. Incorp. Has sewers and electric lights.

History.—Built in '75 by R. R. Thompson.

Water Supply.—Four artesian wells, gathered in receiving well 30 ft. deep, by pumping to tank, and reservoir direct.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two Worthington, one low and one high-pressure. *Boilers:* Hazleton horizontal

Reservoir.—Cap., 6,000,000 galls.

Tank.—Cap., 250,000 galls.; w. i., on top of brick business block, 66 ft. above highest point in the city, and 210 ft. above pumps.

Distribution.—*Mains*, c. i., 68 miles. *Services*, galv. i. *Taps*, 1,500. *Meters*, Crown, 1,500. *Hydrants*, Garrett. 100.

Consumption, 500,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 80 lbs.

Financial—Cost, $363,000. No debt. Ann. op. exp., $19,000. Ann. rev.: consumers, $36,000; city, $7,000. Hydrant rental, $24.

Management.—Owner, R. R. Thompson. Supt., I. L. Borden.

ANAHEIM, *Los Angeles Co.* (Pop., 833; est., 1,100.)

General Description.—Built by town. Supply, wells, pumping to tank. Pump, 700,000-gall. Hooker. *Mains*, 4-in., 1¼ miles. *Hydrants*, 8 or more. *Pressure*, 50 lbs. City Clerk, Max Nebelung. Supt., A. Schneider.

ANDERSON, *Shasta Co.* (Pop., est., 1,200.) Not incorp. No sewers or electric lights.

History.—Built in '87-8 by Anderson Water Co. Engr., Ed. Aldersley.

Water Supply.—Mountain stream, by gravity from impounding to distributing reservoir.

Dam and Reservoir.—Cap., est., 13,000,000 galls.; area, 10 acres; av. depth, 4 ft. Dam, 240 ft. long. *Spillway:* 20 ft. from dam, free. *Discharge-pipe:* one, 12 ins. in diam.; slope, 16 to 1. Dam does not leak. Engr., see History. Cost, $650.

Conduit.—Open ditch, 7 miles long.

Distributing Reservoir.—Cap., 250,000 galls.; 80 ft. in diam.; 8 ft. deep; excavated in soft lava; lined with cem.

Distribution.—*Mains*, 6-in. riveted w. i., 1½ miles. *Services*, ¾-in. *Taps*, not given. *Meters*, none. *Hydrants*, none.

Consumption, unknown. *Pressure*, 75 lbs.

Financial.—Cost, $10,000. Cap. stock, $10,000. No debt. Ann. op. exp., $960. Ann. rev.: total, withheld, est., $1,500.

Management.—Prest., A. L. Sumner. Secy., E. L. Bull. Treas., J. F. Bedford. No Supt. Report by Ed. Aldersley.

ARCH BEACH and LAGUNA, *Orange and San Diego Cos.* (Pop.: Arch Beach, not given; Laguna, est., 800.)

History.—Built in '89-90 by Arch Beach Land and Water Co.; was to be in operation in July, '90. Engr., C. P. Lesley.

Water Supply.—Laguna canyon, by gravity.

Distribution.—*Mains*, 6 miles.

Financial.—Cost, est., $60,000. Cap. stock, $60,000.

Management.—Prest., H. S. Goff, Arch Beach. Secy., E. D. Cooke. Treas., A. B. Judkins. Supt., F. K. Ludlow. Last three of Santa Ana. Report, Feb. 6, '90.

AUBURN, *Placer Co.* (Pop., 2,600.) In mining district. Open sewers, kept clean by automatic flush gates. Has electric lights.

History.—Built in '87 by F. W. Birdsall and known as Auburn Water-Works Co. Des. Engr., F. Birdsall, Sacramento. Const. Engr., Wm. Ambrose. Sub-contr., J. Davis.

Water Supply.—Bear river canal, by gravity to reservoir through 13-in. inverted siphon about 4,000 ft. long, with 120 ft. fall and rise.

Reservoir.—Cap., est., 4,000,000 galls.; area, 1 acre; depth, 15 ft.; excavated in top of hill, 370 ft. above town; embankment, of earth and slate, 5 ft. above water line, 6 ft. broad on top. *Spillway:* excavated in rock, lined with planks and masonry, overflow controlled by gates. *Discharge-pipe:* one, 22 ins. in diam. Reservoir can be emptied in 3 hours. Engr., see History.

Distribution.—*Mains*, w. i., 15½ miles. *Services*, not given. *Taps*, 900. *Meters*, none. *Hydrants*, 30. Pipe, specials, valves and hydrants furnished by W. W. Montague & Co., San Francisco.

Consumption, 200,000 galls. *Pressure*, 370 ft. head.

Financial.—Cost, $40,000. No debt. Ann. op. exp., withheld, est., $1,000. Ann. rev., total, withheld, est., $6,000. Hydrant rental, withheld.

Management.—Owner and Supt., F. W. Birdsall, Sacramento. Secy., Jno. Scott.

AZUSA, *Los Angeles Co.* (Pop., 704; est., 500.) Not incorp. Has sewers. No electric lights.

History.—Built in '87 by Azusa Land & Water Co.

Water Supply.—San Gabriel river, by gravity to reservoir.

Reservoir.—Cap., 1,500,000 galls.; 170 x 120 ft., x 11 ft. deep. Embankment, of dirt and gravel, 15 ft. wide on top, 30 ft. wide at bottom. Inner slope, paved with stones, 6 ins. in diam., laid in mortar and cem. *Discharge-pipe:* one. Reservoir does not leak. Engr. and Contr., see History. Cost, $5,000.

Distribution.—*Mains*, 6-in. c. i., 6 miles. *Services*, 2-in. c. i. *Taps*, 85. *Hydrants*, not given.

Financial.—Cost, $35,000. Cap. stock, $500,000. No debt. Ann. op. exp., withheld, est., $600. Ann. rev., total, withheld, est., $4,000. Hydrant rental, $12 and $18.

Management.—Prest., J. S. Slauson. Secy., James Slauson. Treas., F. C. Howe. Supt., D. A. Shaw.

BAKERSFIELD, *Kern Co.* (Pop., est., 2,500.) On Kern river, which gives water-power. Not incorp. No sewers or electric lights.

History.—Built in '83-4 by Bakersfield Water Co., under 50-years franchise. Eng. and Contr., B. C. Arnold.

Water Supply.—Four artesian wells, pumping to tank. There are two 8-in. and two 10-in. wells.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; two Blake.

Tank.—Cap., 33,000 galls.

Distribution.—*Mains*, 6 and 4-in. iron, 7½ miles. *Services*, not given. *Taps*, (in '87), 600. *Meters*, none. *Hydrants*, 13.

Consumption, 100,000 galls. *Pressure*, 70 to 100 lbs.

Financial.—Cost, $28,000. Cap. stock, $50,000. No debt. Ann. op. exp., $3,000. Ann. rev.: consumers, $7,000; city, none.

Management.—Prest. and Supt, W. H. Scribner. Secy., W. E. Houghton.

BENICIA, *Solano Co.* (Pop., 1,794; est., 2,000.) On Sacramento river, on hilly ground sloping to water. Settled in '47. Incorp. city in '50. Has sewers and electric lights.

History.—Built in '80 by Benicia Water Co., under 20-years franchise.

Water Supply.—Paddy Ranch and Sulphur Springs creeks, by gravity from impounding to distributing reservoir. Water is impounded on each stream, and is pumped from latter to former when rainfall is not sufficient to keep former filled. Drainage area: Paddy Ranch creek, 6 sq. miles; Sulphur Springs creek, 30 sq. miles.

Dams and Impounding Reservoirs.—Cap., 55,000,000 galls. *Paddy Ranch:* Cap., 50,000,000 galls.; area, 2½ acres. Dam, of clay, with heart-wall; 300 ft. long, 25 ft. high, 20 ft. wide at top, 300 ft. at bottom. Slopes, 2½ to 1 unpaved. *Heart-wall:* puddle, 60 ft. thick at bottom, 45 ft. high. *Spillway:* 90 ft. from end of dam; width, 16 ft.; depth, 5 ft., lined with plank, free; slope, 20 to 1, part of the way. *Discharge-pipe:* one 16-in. c. i.; slope, 15 to 1. Dam leaks "some." Built in '80. Engr., W. T. Boardman. Contr., Ah Sing. Cost, $25,000.

Sulphur Springs: cap., 5,000,000 galls. Dam, 40 ft. long on top, 100 at bottom, about 15 ft. high. *Spillway:* at end, controlled by gates having area of 200 sq. ft.

Pumping Machinery.—Dy. cap., 1,200,000 galls.; Corliss comp., cond. A 250,000 Knowles formerly in use.

Conduit.—Consists of 25,000 ft. of 8, 12 and 16-in. c. i.

Distributing Reservoir.—Cap., 1,250,000 galls.; 155 ft. in diam., 15 ft. deep at 192 ft. above tide levels.

Distribution.—*Mains*, c. i., w. i. 7 miles. *Services*, w. i. *Taps*, 398. *Meters*, 47. *Hydrants*, kind not given, 25.

Consumption, 150,000 galls. *Pressure:* Ordinary, 80 lbs. Fire, 100 lbs.

Financial.—Cost, $172,000. Cap. stock, $180,000. Bonded debt, $30,000. Int., 7%. Ann. op. exp., $8,000. Ann. rev.: consumers, $10,900; city, $2,000. Hydrant rental, $48

Management.—Prest., E. H. Nelson. Secy., D. M. Hart. Supt., Alex. Robinson.

BERKELEY, *Alameda Co.* See W. Berkeley.

BODIE, *Mono Co.* (Pop., 2,712; est., 1,500.) In mining region.

History.—Built in '83 by town and Prescott & Co.

Water Supply.—Shaft of mine, pumping to reservoir.

Pumping Machinery.—Dy. cap., 500,000 galls.; Cornish. Owned by Prescott & Co.

Reservoir.—Cap., 180,000 galls.; on hill 120 ft. high.

Distribution.—*Mains*, ¾ miles. *Taps*, 12. *Meters*, none. *Hydrants*, 9.

Financial.—No data.

Management.—Five Comrs. Chf. Engr., H. M. Hartley.

CENTINELA, *Los Angeles Co.* (Pop., est., 400.) In town of Inglewood. Not incorp. Has sewers. No electric lights.

History.—Built in '87-8 by Centilena-Inglewood Land Co. Des. Engr., Wm. Hall, Sacramento. Const. Engr., C. H. Kluegel, Ontario.

Water Supply.—Inglewood springs, developed by excavation and artesian wells, pumping to reservoir. Springs have dy. flow of 1,000,000 galls.

Pumping Machinery.—Dy. cap., 900,000 galls.; Worthington.

Reservoir.—Cap., 500,000 galls.; 76½x163 ft., x 7 ft. deep. Embankment, 12 ft. high. Inner slope, 4 to 1. Sides and bottom lined with brick in cem. Engr. and Contr., see History.

Distribution.—*Mains*, riveted w. i., with screw joints, 15 miles. Contrs. for pipe, specials, trenching and pipe-laying and valves and hydrants, Lacy, Ward & Co., Los Angeles.

Consumption, 50,000 galls. *Pressure*, 90-ft. head.

Financial.—Cost, $40,000. No debt.

Management.—Prest., Geo. J. Ainsworth. Secy. and Treas., R. J. Brewer. Supt., Geo. Tod, Jr.

CHICO, *Butte Co.* (Pop., 3,300; est., 5,000.) On Chico creek. Has extensive lumber mills. Has electric lights.

History.—Built in '75 by Chico Water Co., under 50-years franchise.

Water Supply.—Surface wells, pumping to tank and direct.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; Hooker.

Tank.—Cap., about 9,000 galls.

Distribution.—(In '87.) *Mains*, c. i., 4 miles. *Services*, w. i. *Taps*, 850. *Meters*, none. *Hydrants*, 45.

Consumption, 750,000 galls. *Pressure:* Ordinary, 35 lbs. Fire, 110 lbs.

Financial.—(In '87.) Cost, $75,000. Cap. stock, $100,000. No bonds or debt. Ann. op. exp., $4,000. Ann. rev.: consumers, $12,000; city, $1,920 or about $13 per hydrant.

Management.—Prest. and Gen. Supt., G. W. Dorn. Secy., W. J. Costar.

NOTE.—No report for '89 could be obtained.

CLOVERDALE, *Sonoma Co.* (Pop., 430, est., 1,200.) Incorp. Partially sewered. No electric lights.

History.—Built in '85-6 by Riverside Water Co., under 50-years franchise. Des. Engr., Griffith Colt, San Francisco. Const. Engr., W. D. Sink. Contrs., A. L Fish & G. Coit, San Francisco, and W. D. Sink, Cloverdale.

Water Supply.—Well, 12 ft. in diam., 20 ft. deep, pumping to reservoir.

Pumping Machinery.—Dy. cap., 720,000 galls; Worthington.

Reservoir.—Cap., 268,000 galls.

Distribution.—*Mains*, kind not given, 5¼ miles. *Services*, not given. *Taps*, 150. *Meters*, none. *Hydrants*, Garrett. *Valves*, Garrett.

Consumption, 75,000 galls. *Pressure*, 80 lbs.

Financial.—Cost, $15,000. Cap. stock, $20,000. No bonds or debt. Ann. op. exp., $1,200. Ann. rev.: consumers, $1,600; city, $300. Hydrant rental, $25.

Management.—Prest., J. A. Kleiser. Secy. and Supt., J. L. Sedgeley. Treas. Chas. H. Cooley.

COLTON, *San Bernardino Co.* (Pop., 878.; est., 2,000.) Has flour and lumber mills and canneries.

History.—Plant of Colton Terrace Land & Water Co. bought Jan. 1, '89, by Colton City Water Co., which has 20-years franchise. New works put in operation June 15, '89. No Contrs. Const. Engr. for new work, T. M. Topp. Supt. Construction, E. J. Gilbert. Latter developed additional supply and relaid distribution.

Water Supply.—*Old:* 5 artesian wells, with yield of 15 miner's ins., (3-10 cu. ft., per second), and pressure of 96 ft. in business part of town. *New:* "cienza," with yield of 54 miner's ins. and pressure of 146 ft. in business part.

Distribution.—*Mains*, 14-in., down, Lackawanna steel, about 5 miles; from and laid by J. D. Hooker & Co., Los Angeles; trenching and filling done by Co. *Taps*, 175. *Meters* and *Hydrants*, none.

Pressure, 146 ft. head.

Financial.—Cost, $40,000. Cap. stock, $250,000. No debt.

Management.—Prest., A. B. Miner. Secy., Frank F. Osten. Treas., First National Bank. Report, May 29, '89.

COLUMBIA, *Tuolumne Co.* (Pop., est., 750.) Not incorp. No sewers or electric lights.

History.—Built in '53 by New England Water Co., under 50-years franchise.

Water Supply.—Springs and Stanislaus river, by gravity.

Reservoirs.—Cap., 90,000 galls., two.

Distribution.—*Mains*, c. i., 5 miles. *Services*, lead. *Taps*, 75. *Meters* and *Hydrants*, none.

Consumption, 30,000 galls. *Pressure*, 30 lbs.

Financial.—Cost, $24,000. No debt. Ann. op. exp., $800. Ann. rev.: consumers, $1,100; city, none.

Management.—Prest. and Treas., W. H. Hilton. Secy. and Supt., A. Tarleton.

COLUSA, *Colusa Co.* (Pop., 1,779; est., 2,000.) On Sacramento river. Settled in '51; incorp. in '70. No sewers or electric lights.

History.—Built in '69, rebuilt in '74 and '88 by J. B. Cooke.

Water Supply.—Sacramento river, pumping to tanks.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Knowles, with 10-in. steam and water cylinders of 14-in. stroke, and Worthington pump, added in '88, with 8-in. high and 12-in. low-pressure steam, and 12-in. water cylinders, all of 10-in. stroke.

Tanks.—Cap., 22,000, 68,000 and 25,000 galls., respectively; first two are of wood, one 20 and other 34 ft. in diam., each 10 ft. high; last tank was built in '89, on trestle 92 ft. high, and is used for fire only, being connected with both pumps. In case of fire, connection with first tanks is cut off.

Distribution.—*Mains*, 8 to 4-in. c. i., 5½ miles; in '87 all wooden mains were replaced with iron. *Services*, iron. *Taps*, 300. *Meters*, 1. *Hydrants*, kind not given, 15.

Consumption, 250,000 galls. *Pressure:* Ordinary, 24 lbs. Fire, 40 lbs.

Financial.—Cost, $34,000. No debt. Ann. op. exp. (in '87), $4,000. Ann. rev. (in '87): consumers, $7,073; city, $300. Hydrant rental, $20.

Management.—Owner and Supt., J. B. Cooke.

CUCAMONGA, *San Bernardino Co.* (Pop., est., 300.) Not incorp. No sewers or electric lights.

History.—Built by Cucamonga Water Co., date not given, principally for irrigating purposes. Engr., E. T. Wright, Los Angeles.

Water Supply.—Tunnels into volcanic hill and artesian wells, by gravity through reservoirs.

Reservoirs.—Five; cap., 2,000,000 to 3,000,000 galls. each.

Distribution.—*Mains*, material not given, 41 miles. *Services*, *Taps*, *Meters* and *Hydrants*, not given.

Consumption and *Pressure*, not given.

Financial.—Cost, $103,000. No debt. Ann. op. exp., $1,000. Ann. rev.: consumers, $800.

Management.—Prest., J. C. Lynch. Secy., O. C. Matthay. Treas., E. I. Wright. Supt., T. G. Graham.

DUTCH FLAT, *Placer Co.* (Pop., est., 500.) On ridge between Bear and American rivers, 3,400 ft. above the sea. Settled in '46. Not incorp. No sewers. Has electric lights.

History.—Built in '59 by an individual, and now owned by Isaac T. Coffin.

Water Supply.—Springs, by gravity from collecting reservoir.

Reservoir.—Cap., about 180,000 galls.; 50 x 60 ft., x 8 ft. deep, and 175 ft. above town.

Distribution.—*Mains*, 13 to 6-in. w. i. and cem., and c. i., 1 mile. *Services*, wood, w. i. *Taps* (in '87), 80. *Meters*, none. *Hydrants*, 16.

Consumption, 10,000 galls. *Pressure*, 170 lbs.

Financial.—Cost, $5,000. No debt. Ann. op. exp., $500. Ann. rev.: consumers, $1,000; city (in '87), $100. When works were built town granted bonus of $2,000, on condition that water was furnished for fire protection, and mains and hydrants kept in repair, natural wear excepted.

Management.—Owner and Supt., Isaac T. Coffin.

ESCONDIDO, *San Diego Co.* (Pop., est., 1,000.) Incorp.

History.—Built in '87-8 by Escondido Land & Water Co. Engr., E. L. Dorn.

Water Supply.—Three wells, 20 ft. in diam., 12 ft. deep, sunk in bed of river pumping to reservoir.

Reservoir.—Is 96x135 ft..x12 ft. deep.

Pumping Machinery.—Dy. cap., 1,152,000 galls.; Worthington; from A. S. Fish, San Francisco.

Distribution.—*Mains*, 6 to 2-in. w. i., 3 miles. Contrs., Crane Bros. Mfg. Co., Chicago, Ill. *Taps*, 75. *Meters*, none. *Hydrants*, 6.

Consumption, 50,000 galls. *Pressure*, 60 lbs.

Financial.—Cost, $32,500. Cap. stock, authorized, $500,000. No debt. Ann. op. exp., $1,800. Ann. rev.: consumers, $1,800; city, not given.

Management.—Prest., J. Greendike. Secy., J. R. Thomas. Mgr., W. W. Thomas. Supt., John T. Chambers.

NOTE.—Above from '88 MANUAL, Supt. reporting "no change."

EUREKA, *Humboldt Co.* (Pop., 2,639; est., 7,000.) On Humboldt bay, 7 miles from ocean. Engaged in lumbering. Incorp. Has sewers and electric lights.

History.—Built in '79 by C. S. Ricks, under 25-years franchise. In '89 estate of C. S. Ricks sold works to Ricks Water Co., which was incorp. March 5, '89. Extensions and improvements were completed about Nov. 1, '89.

Water Supply.—*Old:* Combined surface and artesian wells, pumping to tank. Surface well, 20 ft. sq., 47 ft. deep; in its bottom are 4 artesian wells, 896, 293, 172 and 100 ft. deep, respectively. *New:* Elk river, pumping direct.

Pumping Machinery.—Dy. cap., 1,850,000 galls.; Knowles; 1,500,000 comp., added in '89, and three old pumps.

Force Main.—Diam., 13 ins.; length, 5½ miles.

Old Tank.—Cap., 46,000 galls.

Distribution.—*Mains*, w. i., 8 miles. *Services*, w. i. *Taps*, 450. *Meters*, 8 *Hydrants*, Garrett, 6.

Consumption, 325,000 galls. *Pressure:* Ordinary, 70 lbs. Fire, 100 lbs.

Financial.—Cost, $55,147. No debt. Ann. op. exp. $3,600. Ann. rev.: consumers, $7,507. *Hydrants*, free.

Management.—Prest., R. Sweasey. Secy and Supt., H. L. Ricks.

FELTON, *Santa Cruz Co.* (Pop., 271; est., 400.)

History.—Built in '89 by Felton Water Co.; put in operation about Aug. 1. Engrs., T. Wright and E. J. Bubottom. Labor done by Co.

Water Supply.—Bull creek, by gravity.

Distribution.—*Mains*, 5-in. iron, 1.3 miles.

Pressure, 260-ft. head.

Financial.—Cost, $3,000. Cap. stock, $10,000.

Management.—Officers: Wm. Russell, C. H. Winter, W. A. Walker. Report, July 21, '89.

FERNDALE, *Humboldt Co.* (Pop., est., 1,500.) Not incorp. No sewers or electric lights.

History.—Built in '73; now owned by Mrs. Grace Francis and leased and operated by George M. Brice.

Water Supply.—Spring, by gravity.

Reservoirs.—Cap., 300,000 galls.; two, 100,000 and 200,000 galls.

Distribution.—*Mains*, 4-in., riveted sheet-iron, 7 miles. *Services*, galv. i. *Taps*, 140, "allowing one for each building." *Meters*, none. *Hydrants* [probably], none.

Consumption, 50,000 galls. *Pressure*, 25 lbs.

Financial.—Cost, about $18,500. No debt. Ann. op. exp., $500. Ann. rev.: consumers, $2,000; city, none.

Management.—Lessee, George M. Brice. Report, Feb. 17, '90.

FITCHBURG, *Alameda Co.* See Alameda.

FRESNO, *Fresno Co.* (Pop., 1,112; est., 10,000.) Incorp. Has sewers and electric lights.

History.—Built in '76 by Fresno Water Co. Engr., W. S. Murty, Jr.

Water Supply.—Wells, pumping to tanks. In '85 there were two wells, one 8 and one 10 ins. in diam., each 100 ft. deep.

Pumping Machinery.—Dy. cap., 3,500,000 galls.; two 750,000 Holly, one 2,000,000 Worthington.

Tanks.—Cap., 200,000 galls.

Distribution.—*Mains*, c. i., w. i., 27 miles. *Services*, black i. *Taps*, 2,000. *Meters*, none. *Hydrants*, Garrett, 25. *Valves*, Garrett.

Consumption, 2,500,000 galls. *Pressure*, 40 lbs.

Financial.—Cost, withheld, est., $250,000. Cap. stock (in '88), $200,000. Bonds, not given. No debt. Ann. op. exp. (in '87), $10,000. Ann. rev. (in '87): consumers, $14,000; city, $600. Hydrant rental, $24.

Management.—Prest., Louis Leach. Secy., J. M. Collier. Supt., Jas. K. Allen.

GILROY, *Santa Clara Co.* (Pop., 1,621; est., 2,200.) In a level valley. Settled in '50. Incorp. No sewers or electric lights.

History.—Built in '71-2, and now owned by city. Works were originally owned by a Co.

Water Supply.—Uvas river, 11½ miles distant, by gravity to reservoir, with pumping from wells in extreme dry weather. Wells are 11 ins. in diam., and 100 and 150 ft. deep, respectively.

Dam.—No data.

Conduit.—Of hard wood lumber, 18 ins. sq , for 6 miles, then of 17 to 13-in. w. i. pipe for 3 miles.

Reservoir.—Cap. not given; 2½ miles from and 90 ft. above town.

Pumping Machinery.—Dy. cap., 2,400,000 galls.; Hooker.

Distribution.—*Mains*, 3-in. w. i., 3 miles. In addition there are 6 miles of wooden conduit and 5½ miles of w. i. conduit and supply mains. *Services*, w. i. *Taps*, 250. *Meters*, none. *Hydrants*, 8.

Consumption, unknown. *Pressure*, 40 lbs.

Financial.—Cost of construction, $94,000; city paid $18,000. Bonded debt, $15,000. Int., 7%. Ann. op. exp., est., $1,500. Ann rev.: consumers, $4,500.

Management.—Supt., Jno. W. Norris.

NOTE.—Jan. 26. '89. village voted to issue $50,000 of bonds for works: these to be sold not less than par, and not to bear more than 5% int. Proposals for bids for bonds and for c. i. pipe had been asked, the middle of Feb., '89. No later report concerning new works has been received.

GRASS VALLEY, *Nevada Co.* (Pop., 6,688.) In quartz mining and lumbering district, and has manufactories. Settled in '49; incorp. town in '54. Has sewers and electric lights.

History.—Built in '66-7 by town, without Engr.

Water Supply.—South Yuba river, 6 miles distant, by gravity, through open ditch to reservoirs.

Reservoirs.—Three; 210 ft. above town; 300 x 500 ft., 100 x 150 ft., and 300 ft. sq., respectively.

Distribution.—*Mains*, 6-in. c. i., 10 miles. *Services*, w. i. *Taps*, 700. *Meters*, none. *Hydrants*, 68.

Consumption, "100 inches, miners' measure," or about 170,000 galls. *Pressure* 100 lbs.

Financial.—Cost (in '87), $80,000. Debt and int., withheld. Ann. op. exp., $6,000. Ann. rev.: consumers, $9,000.

Management.—Town Trustees. Gen. Mgr., J. J. Dorsey.

HAYWARDS, *Alameda Co.* (Pop., 1,231; est., 2,000.) Incorp. No sewers. Has electric lights.

History.—Built in '88 by Knox Bros., under 50-years franchise.

Water Supply.—Wells, pumping to reservoir and direct. Well, 25 ft. in diam., 55 ft. deep, constructed in '89; in bottom is tunnel 100 ft. long.

Reservoir.—Cap., 650,000 galls.; 52 x 100 ft., x 16 ft., lined with cem.; is 100 ft. above town.

Pumping Machinery.—Dy. cap., 1,600,000 galls.; Dow; 600,000 and two 500,000; latter added in '89; are set 3 ft. below water line, incased in substantial concrete foundation and walls.

Distribution.—*Mains*, 8 to 4 in. black i., 5 miles. *Services*, not given. *Taps* 120. *Meters*, from San Francisco Tool Co., 6. *Hydrants*, 22.

Consumption, 50,000 galls. *Pressure:* Ordinary, 50 to 70 lbs. Fire, 60 to 80 lbs.

Financial.—Cost, $30,000. No debt. Ann. op. exp., $4,500. Ann. rev.: consumers, $3,600; city, $1,500.

Management.—Owner, W. Knox.

HEALDSBURGH, *Sonoma Co.* (Pop., 1,133; est., 3,500.) On Russian river.

History.—Built by F. & A. Koenig, under 50-years franchise.

Water Supply.—Springs, pumping to reservoir.

Pumping Machinery.—Dy. cap., 500,000 galls.; Blake. *Boiler:* 40-H. P.

Reservoir.—Cap., 500,000 galls.

Distribution.—*Mains*, 6-in. i., 3 miles. *Taps*, 200. *Meters*, none. *Hydrants*, 12. Further details not given.

Financial.—Cost, $30,000. No debt. Ann. op. exp., $600. Ann. rev.: withheld; est., $4,000.

Management.—Supt., F. Koenig.

NOTE.—Report for '89 says "no change" from previous issue.

HOLLISTER, *San Benito Co.* (Pop., 1,034; est., 2,000.) Settled in '70. Incorp. No sewers or electric lights.

History.—Built in '76 by private Co., name not given, under 50-years franchise. Des. Engr., R. M. Shackelford.

Water Supply.—Three artesian wells, pumping to reservoir. Each well is 10 ins. in diam., 85 ft. deep.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; Knowles, with 15½-in. steam and 10-in. water cylinders. *Boilers:* two tubular.

Reservoir.—Cap., 300,000 galls.; in excavation, lined with brick in cem., at 120 ft. above town.

Distribution.—*Mains*, c. i., w. i., 11 miles. *Services*, w. i. *Taps*, 350. *Meters*, none. *Hydrants*, 30.

Consumption, 300,000 galls. *Pressure*, 47 lbs.

Financial.—Cost, $35,000. Cap. stock, withheld. No debt. Ann. op exp., $2,000. Ann. rev.: consumers, $1,500.

Management.—Prest., Secy. and Supt., T. S. Hawkins.

INDEPENDENCE, *Inyo Co.* (Pop., est., 250.) Not incorp. No sewers or electric lights.

History.—Built in '87 by Independence Water Co., under 50-years franchise. Engr., S. D. Thurston.

Water Supply.—Pinyon and Pine creeks, by gravity.

Distribution.—*Mains*, spiral-riveted w. i., 2 miles. *Services*, w. i. *Taps*, 25. *Meters*, none. *Hydrants*, kind not given, 5.

Consumption, 20,000 galls. *Pressure*, not given.

Financial.—Cost, $7,650. Ann. op exp., $200. Ann. rev.: consumers, $870. Hydrant rental, $24.

Management.—Prest., E. Robinson. Secy., A. R. Conklin. Supt., J. A. Lamb.

INGLEWOOD, *Los Angeles Co.* See Centinela.

JACKSON, *Amador Co.* (Pop., 1,040; est., 1,500.) In mining region. Not incorp. No sewers or electric lights.

History.—Built in '65; now owned by B. F. Richtmeyer. No Engr. employed.

Water Supply.—Springs, and Blue Lakes Water Co.'s canal, by gravity, water passing to reservoir from former and to tank from latter.

Reservoir and Tank.—No data.

Distribution.—*Mains*, 11 to 2-in. w. i., 2.4 miles. *Services*, not given. *Taps*, 190. *Meters*, none. *Hydrants*, 13.

Consumption, not known. *Pressure*, 170-ft. head.

Financial.—Cost, $25,000. No debt. Ann. op. exp., $750. Ann rev.: consumers, withheld, est., $4,000; city, not given.

Management.—Proprietor and Supt., B. F. Richtmeyer.

LAGONIA, *San Bernardino Co.* (Pop., est., 400.) See Redlands.

LAGUNA, *San Diego Co.* See Arch Beach.

LIVERMORE, *Alameda Co.* (Pop., 855; est., 2,000.) Incorp. No sewers. Has electric lights.

History.—Built in '75-6 by Aylward & Mullany, and known as Livermore Spring Water Co., under 50-years franchise. Des. Engr., W. F. Boardman.

Water Supply.—Livermore springs, pumping to reservoirs, and Arroyo Mocho river, by gravity. Pumping is used for 6 or 7 months of the year, and gravity supply remainder.

Pumping Machinery.—Dy. cap., 480,000 galls.; from Aylward's Agricultural Works, Livermore.

Reservoirs.—Cap., 1,000,000 galls.; 3, in excavation, puddled.

Distribution.—*Mains*, riveted w. i., 12 miles. *Services*, not given. *Taps*, 400. *Meters*, not given. *Hydrants*, New York, 15. *Valves*, Garrett.

Consumption, 80,000 galls. *Pressure*, 25 lbs.

Financial.—Cost, $35,000. Debt, $3,700. Int., 8%. Ann. op. exp., $360. Ann. rev.: consumers, withheld, est., $10,000. Hydrants, free.

Management.—Supt., Jno. Aylward.

NOTE.—Report says no change of note from '88 MANUAL.

LOS ANGELES, *Los Angeles Co.* (Pop., 11,183; est., 50,000.) On Los Angeles river, at an elevation of 100 to 309 ft. Incorp. city in '58. Has sewers and electric lights.

LOS ANGELES CITY WATER CO.'S SYSTEM.

History.—Begun in '62 and rebuilt or extended in '68-9, under 30-years franchise. Contrs., Harper & Reynolds Co., Los Angeles.

Water Supply.—Los Angeles river, by gravity to and from reservoir. A 2,000,000 pumping plant is to be added, in '90, to supply elevated territory where gravity pressure is insufficient.

Old Wing Dam and Ditch.—Dam is of brush and sand, extending into river to divert water to open ditch, 7 miles long, leading to reservoir. Infiltration system was substituted, in '89, for this dam and ditch.

Dam and Reservoir.—Cap., 15,000,000 galls.; reservoir was increased in size in '82 by excavating its bottom to solid rock. Previously its cap. was 7,000,000 galls. Dam of masonry, across canyon.

Filter.—Dy. cap., 7,000,000 galls. Built in '89. Water is procured from river by sub-drainage Sewer-pipe, with dry joints is laid in gravelly margin of river, there being two main lines with fall of 1 in. in 1,000 ft. Rapid fall of river, about 20 ft. to the mile, enables pipe to attain depth of 14 ft. in less than a mile. Excavation was made with steam shovel at cost of less than 5 cents per yard. To be enlarged in 90.

Distribution.—*Mains*, c. i., w. i., 250 miles. Cement lined sheet iron mains have been used, but did not give satisfaction. *Services*, galv. i. *Taps*, 8,200. *Meters*. 60. *Hydrants*, Ludlow, 190. *Valves*, Ludlow.

Consumption, 6,000,000 galls. *Pressure*, 100-ft. head

Financial.—Cost, $1,200,000. Cap. stock, $1,200,000. Bonded debt, $300,000. Int., 6%. Ann. op. exp., $21,000. Ann. rev.: consumers, $215,000, Hydrants free.

Management.—Prest., Wm. H. Perry, Secy., S. H. Mott. Supt., Wm Mulholland.

CITIZENS' WATER CO.'S SYSTEM.

History.—Built in '73-4, under 50-years franchise. Contrs., Harper & Reynolds Co., Los Angeles. Water Co. now does its own work.

Water Supply.—Los Angeles river, by gravity and by pumping to reservoirs Gravity supply has head of 438 ft.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Worthington and Hooker.

Filter.—Dy. cap., 325,000 galls.; Hyatt.

Reservoirs. Cap., 5,000,000 galls. Three, of which highest reservoir has elevation of 580, and lowest of 445 ft.

Distribution.—*Mains*, c. i., w. i., 55 miles. *Services*, galv. i. *Taps*, 2,000. *Meters*, 15. *Hydrants*, not given.

Consumption, 1,000,000 galls. *Pressure*, not given.

Financial.—Cost (in '87), $375,000. Debt, $200,000. Int., 6%. Ann. op. exp., $25,000. Ann. rev.: consumers, $58,000.

Management.—Prest. and Treas., M. L. Wicks. Secy., L. M. Anderson. Supt., Johnson Reynolds.

MARTINEZ, *Contra Costa Co.* (Pop., est., 2,000.) Incorp. No sewers or electric lights.

History.—Built in '85 by Geo. W. McNear, under 20-years franchise. Contr., W. B. Thomas.

Water Supply.—Reservoir, pumping to tank. No filtration.

Pumping Machinery.—Dy. cap., 250,000 galls.; Dow.

Distribution.—*Mains*, 6-in., iron, 1 mile. *Taps*, 50. *Hydrants*, 20.

Financial.—No debt.

Management.—Owner, Geo. W. McNear. Report by J. McCann; date, Mar., '89.

MARYSVILLE, *Yuba Co.* (Pop., 4,321; est., 5,000.) On Yuba river, in agricultural and mining district. Has electric lights.

General Description.—Built for general supply prior to '89 by Marysville Water Co Supply, flowing artesian well, pumping to tanks. Secy., E. E Meek. All other officials are non-residents. Report by F. E. Smith; date, Aug. 7, '89.

MENLO PARK, *San Mateo Co.* (Pop., 225.) Not incorp. No sewers or electric lights.

History.—Built in '64 by Menlo Park Water Co. Extension projected for '90.

Water Supply.—Surface water, by gravity.

Reservoir.—Cap., 125,000,000 galls; area, 15 acres.

Distribution.—*Mains*, w. i., 11 miles. *Services*, w. i. *Taps*, 125. *Meters* 48. *Hydrants*, none.

Consumption, unknown. *Pressure:* Ordinary, 40 lbs. Fire, 60 lbs.

Financial.—Cost, $250,000. Cap. stock and bonds not given. No floating debt. Ann. op. exp., withheld, est., $2,000. Ann. rev.: consumers, withheld, est., $5,000; city, none.

Management.—Prest., C. N. Felton. Secy., L. C. Fraser. Supt., D. J. Mills.

MERCED, *Merced Co.* (Pop., 1,466; est., 4,000.) Has electric lights.

History.—Built in '80-1 by W. L. Sillman & J. J. Stevenson, under 25-years franchise.

Water Supply.—Artesian well, 160 ft. deep, pumping to tank and direct.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Knowles.

Tank.—No data.

Distribution.—(In '87.) *Mains*, w. i., 3¾ miles. *Services*, w. i. *Taps*, 212. *Meters*, not given. *Hydrants*, 4.

Consumption (in '87), 100,000 galls. *Pressure:* Ordinary, 20 lbs. Fire, 75 lbs.

Financial.—(In '87.) Cost, $12,500. Cap. stock, $12,000. No debt. Ann. op. exp., $1,800. Ann. rev.: consumers, $5,000; city, $200. Hydrant rental, $50.

Management.—Supt., A. C. Swain.

NOTE.—No report for '89 could be obtained.

MISSION SAN JOSE, *Alameda Co.* (Pop., 246.)

History.—Built in 70 by Co.

Water Supply.—Springs, by gravity.

Reservoir.—Cap. 100,000 galls.

Distribution.—(In '87.) *Mains*, w. i., ½ mile. *Taps*, about 30. *Hydrants*, 12. *Consumption*, 20,000 galls.

Financial.—Cost withheld, est., $4,000. Ann. op. exp., about $40. Ann. rev.: consumers, about $600.

Management.—Supt., Juan Galleges.

NOTE.—No report for '89 could be obtained.

MODESTO, *Stanislaus Co.* (Pop., 1,693; est., 3,200.) On generally level land ½ mile from Tuolumne river. Settled in '70. Incorp. No sewers or electric lights.

History.—Built in 76 by Modesto Water Co., under 50-years franchise. Des. Engr., Jno. Hamilton. Extensive improvements contemplated for '90, including new wells, a stand-pipe, and a 1,000,000-gall. pump.

Water Supply.—Artesian wells, pumping to tanks. There are two 10 in. wells, each 116 ft. deep, having a dy. yield of 1,200,000 galls.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; two Blake, one with 10 x 12-in. steam, 9-in. water cylinder, other with 12 x 14-in. steam, 8-in. water cylinder.

Tanks.—Cap., 100,000 galls.; 112 ft. above pumps.

Distribution.—*Mains*, w. i., 8 miles. *Services*, w. i. *Taps*, 450. *Meters*, none. *Hydrants*, 15.

Consumption, 400,000 galls. *Pressure*, 30 lbs.

Financial.—Cost, $10,000. Cap. stock, $20,000. Undivided profit, $20,000. No debt. Ann. op. exp., $7,125. Ann. rev.: consumers, $9,960; city, $644. Hydrants, free.

Management.—Prest. and Supt., Robt. McHenry. Secy., Ora McHenry.

MONTEREY, *Monterey Co.* (Pop., est., 1,400.) On Monterey bay. See Pacific Grove.

NAPA CITY, *Napa Co.* (Pop., 3,731; est., 5,000.) On Napa river, in valley between high hills. Settled in '54. Incorp. city in 74. Has sewers and electric lights.

History.—Built in '83-4 by Napa City Water Co. Des. Engr., G. F. Allardt. Const. Engr., O. H. Buckman. Labor done by local parties.

Water Supply.—Surface well, pumping to reservoir. In dry weather, river is drawn upon.

Well and Tunnel.—Well is 5 ft. in diam., 47 ft. deep, and from point 40 ft. below surface, tunnel 6 ft. wide and 4 ft. high extends through volcanic rock for 126 ft. to point beneath saturated gravel stratum, with which it connects.

Pumping Machinery.—Dy. cap., 720,000 galls; Harper comp., made by W. T. Garrett & Co.; 12 and 20 x 20 in. steam, 12-in. water cylinders.

Dam and Reservoir.—Cap., 2,500,000 galls.; 100 ft. above city. Dam, of masonry, 167 ft. long, 33 ft. high, 7 ft. wide at top, 22½ ft. wide at bottom; built across ravine.

Distribution.—*Mains*, c. i., 6½ miles. *Services*, galv. i., Pipe and specials from R. D. Wood & Co., Philadelphia, Pa. *Taps*, 600. *Meters*, 24. *Hydrants*, Garrett, 41. *Pressure-recording gauge*, Edson.

Consumption, not given. *Pressure*, 45 lbs.

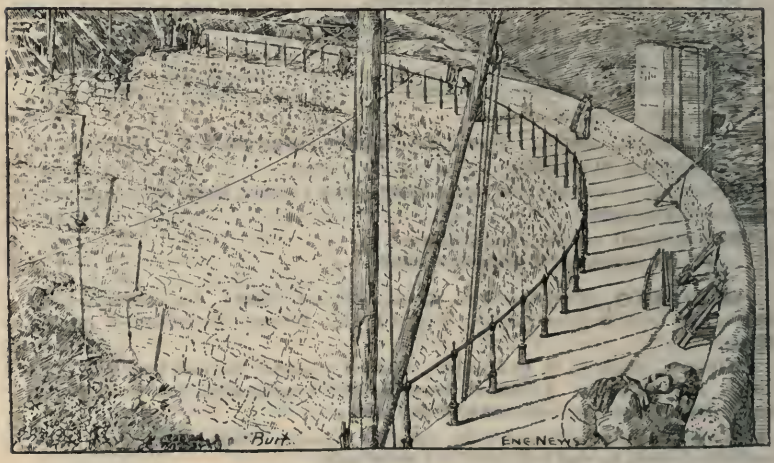
Financial.—Cost, $126,600. Cap. stock, $150,000. No debt. Ann. op. exp., $7,500. Ann. rev.: consumers, $16,000; city, $1,200. Hydrant rental, $30.

Management.—Prest., S. E. Holden. Secy., E. S. Churchill. Treas., G. E. Goodman. Supt., T. R. Parker.

NATIONAL CITY, *San Diego Co.* (Pop., 387; est., 6,000.) On San Diego bay. Has railway repair shops. Incorp. No sewers or electric lights.

History.—Built in '86-8 by San Diego Land and Town Co., of Boston, Mass. Engr., Jas. D. Schuyler.

Water Supply.—Sweetwater river, by gravity from impounding reservoir.



Sweetwater Dam, National City, Cal.

Sweetwater Dam and Reservoir.—Cap., 6,000,000,000 galls.; area, 720 acres; ¾ x 3 miles. Dam is 98½ ft. high, 46 ft. thick at bottom, 12 at top, 360 ft. long on crest, of curved type, with a radius of 213 ft. Masonry, rough rubble, laid in Portland cem. and sand, 1 to 3. Illustrations and a full description of this dam will be found in *Engineering News*, vol. XIX., pp. 270 1. See accompanying view.

Distribution.—*Mains*, w. i., 65½ miles; from National Tube Works, McKeesport, Pa. *Services*, galv. i. *Taps*, 315. *Meters*, 8. *Hydrants*, kind not given, 38.

Consumption, 2,500,000 galls. *Pressure*, 45 lbs.

Financial.—Cost, $780,526. No debt. Ann. op. exp., $8,000. Ann. rev.: consumers, $12,000; city, $1,700. Hydrant rental, $35.

Management.—Prest., Benj. Kimball, Boston, Mass. Secy., E. Wilder, Topeka, Kans. Gen. Mgr., Wm. G. Dickinson.

NEVADA CITY, *Nevada Co.* (Pop., 4,022; est., 6,000.) On Deer Creek, in mountainous mining region. Engaged in lumbering and manufacturing. Has electric lights.

History.—Built in '61 by Co.

Water Supply.—South Yuba river, by gravity.

Reservoirs.—Cap., 1,000,000 galls.; three, 212 ft. above city.

Distribution.—(In '87.) *Mains*, c. i., 4½ miles. *Services*, galv. i. *Taps*, 400. *Meters*, 4. *Hydrants*, 41.

Consumption (in '87), 680,000 galls. *Pressure*, 212-ft. head.

Financial.—(In '87.) Cost, $38,000. No debt. Ann. op. exp., $4,800. Ann. rev.; consumers, $12,000; city, $4,100. Hydrant rental, $100.

Management.—Supt., J. E. Brown.

NOTE.—No report for '89 could be obtained.

NIPOMO, *San Luis Obispo Co.* (Pop., est., 500.) Not incorp. No sewers or electric lights.

History.—Built in '87 by Nipomo Water Co. Des. Engrs., S. A. Dana and P. Fry. Const. Engr., A. H. Armstrong. Sub-contrs., A. Dixie and V. S. Runels & Sons.

Water Supply.—Mountain springs, by gravity to reservoir.

Reservoirs.—Cap., 32,000 galls.; two, one of which is 70 ft. sq. x 6 ft. deep.

Distribution.—*Mains*, 4-in., 2 miles. *Services*, not given. *Taps* (in '87), 99. *Meters* and *Hydrants*, not given.

Consumption, 15,000 galls. *Pressure*, not given.

Financial.—Cost, $23,500. Cap. stock, $25,000 Debt, $2,000. Int., 10%. Ann. op. exp., $300. Ann. rev.: consumers., $1,000; city, none. Hydrant rental, free.

Management.—Prest., T. S. Thayer. Secy., S. A. Dana. Treas., P. Fry. Supt., W. Adams.

OAKDALE, *Stanislaus Co.* (Pop., 376; est., 2,000.) Not incorp. No sewers or electric lights.

History.—Built in '85 by individual. Des. Engr., A. Rand, Supt. Const. Engr., A. Woolf.

Water Supply.—Well, pumping to reservoir.

Pumping Machinery.—Dy. cap., 250,000 galls.; Dow.

Reaervoir.—Cap., 80,000 galls.

Distribution.—*Mains*, 6-in. w. i., 1 mile. *Taps*, 200. *Meters*, none. *Hydrants*, 8.

Consumption, 100,000 galls. *Pressure:* Ordinary, 50 lbs. Fire, 120 lbs.

Financial.—Cost, $19,000. Cap. stock and debt, withheld. Ann. op. exp., $2,500. Ann. rev.: total, withheld, est., $3,000. Hydrant rental, $48.

Management.—Supt., A. Rand. Report, Feb. 11, '90.

OAKLAND, *Alameda Co.* (Pop., 34,555; est., 45 000.) On San Francisco bay, on flat, low, sandy ground; back of city, hills rise to height of 1,500 ft. Settled in '51; incorp. city in '54. Has electric lights.

History.—Built in '68 by Contra Costa Water Co. No special franchise. Des. Engr., Anthony Chabot. Const. Engr., W. F. Boardman. Co. also supplies San Leandro and Lake Chabot.

Water Supply.—Artificial lakes, by gravity to reservoirs, and artesian wells, by pumping to reservoir to supply highest parts of city. Drainage area, 49 sq. m.

Dams.—Two, of earth, built across creeks. That forming Lake Chabot is 300 ft. long, 80 ft. high, and 310 ft. wide at base. Second dam not described.

Lake Chabot.—Cap., 5,000,000,000 galls.; covers 400 acres, drains 44 sq. m., and is 200 ft. above city. Unofficially reported that in '88 a 2,000,000-gall. filter basin was put in near this lake.

Seneschal Lake.—Cap., 270,000,000 galls.; covers 18 acres, drains 5 sq. m., and is 400 ft. above city.

Conduit.—In '82, water passed from Lake Chabot through screens formed by tacking cotton cloth on frames, into a 24-in. asphalt-coated, riveted w. i. pipe leading to distributing reservoir.

Distributing Reservoirs.—Cap., 3,000,000 galls.; three.

Pumping Machinery.—Dy. cap., 500,000 galls; Cameron deep-well, lifting water from wells to reservoir for high service. In '84, a 500,000 Dow was added, but is not included in last report.

Distribution.—(In '87.) *Mains*, c. i., w. i. and cem., 164 miles. Previous to '78 distribution was wholly by w. i. and cem. pipe. In '82 it was stated that preference was for boiler-iron riveted pipe, coated with asphalt and lined with cem. *Services*, galv. i. *Taps*, 7,400. *Meters*, 150. *Hydrants*, Chabot, 21.

Consumption, 7,000,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 50 to 90 lbs.

Financial.—(In '87.) Cost, $5,200,000. Cap. stock, $3,000,000. Debt, $1,075,000, of which $900,000 is in bonds. Int., 6%. Ann. op. exp., $120,000. Ann. rev.: consumers, $260,000; city, $20,000. Hydrant rental, $60.

Management.—(In '88.) Prest., Henry Tierce. Secy., Wm. H. Mead. Supt., Chas. Purcell.

NOTE.—No report for '89 could be obtained.

OCEANSIDE, *San Diego Co.* (Pop., est., 1,200.) Not incorp.

History.—Built in '86 by Oceanside Water Co., under direction of officers. Labor done by Co.

Water Supply.—River, pumping to reservoir.

Pumping Machinery.—Dy. cap., 69,000 galls.; make not given.

Reservoir.—Cap., about 150,000 galls.

Distribution.—(In '87.) *Mains*, w. i., 5 miles. *Services*, w. i. *Taps*, 44. *Meters*, none. *Hydrants*, none.

Consumption, not given. *Pressure*, 92 lbs.

Financial.—(In '87.) Cost, about $10,000. Cap. stock, $12,000. No debt. Ann. op. exp. (for '86), $700. Ann. rev.: consumers (for '86), $800; city, none.

Management.—(In '88.) Prest., A. J. Meyers. Secy., J. E. Meyers. Supt., E. W. Scott.

NOTE.—No report for '89 could be obtained.

ONTARIO, *San Bernardino Co.* (Pop., est., 2,000). On San Antonio river.

SAN ANTONIO WATER CO.'S WORKS.

History.—Built in '83. Engr., J. C. Dunlap, Los Angeles. Des. Engr. for late improvements and extensions, Geo. Chaffer. Const. Engr. for same, F. E. Trask.

Water Supply.—San Antonio creek and infiltration tunnel beneath same, by gravity. Large part of water used for irrigation.

Infiltration Tunnel.—Driven beneath bed of creek; 3½ ft. wide at bottom, 2 at top, 6 ft. high; to be about one mile long; about 3,000 ft. driven June 22, '89. Driven through boulders and gravel: quicksand giving trouble at above date. Alignment practically straight; grade, 1 in. to 1 rod, generally. Cost, for first 2,000 ft., about $5 per l. ft.; next 1,000 ft., from $7 to $20 per l. ft. Lined with concrete blocks to above dimensions.

Distribution.—*Mains*, c. i. and cem., 80 miles; mostly for irrigating. *Services*, w. i. *Taps*, 150. *Meters* and *Hydrants*, none.

Consumption, 3,000,000 galls. *Pressure*, 150 lbs.

Financial.—Cost, $300,000. Cap. stock (authorized in '88), $1,500,000. No debt. Ann. op. exp., $2,400. Ann. rev.: consumers, $2,560; city, $800.

Management.—Prest., S. P. Hildreth. Secy., W. J. Waddingham. Treas., Ontario State Bank. Engr. and Supt., F. E. Trask.

ONTARIO LAND AND IMPROVEMENT CO.'S WORKS.

History.—Built in '87-9, under perpetual, exclusive franchise. Engr., F. E. Trask. Labor done by Co.

Water Supply.—Mountain stream and tunnel in San Antonio canyon, by gravity; head, 1,500 ft.

Distribution.—*Mains*, 12 and 6-in. c. l., 4 and 3-in. lap-welded w. i., 7 miles. *Services*, 1 and ¾-in. lap-welded w. i.

Consumption, 207,000 galls. *Pressure*, 125 lbs.

Financial.—Cost, $20,000. Cap. stock, authorized and paid up, $500,000. Debt, none.

Management.—Prest., C. E. Harwood. Secy., W. E. Collins. Treas., Ontario State Bank. V. Prest. and Mgr., C. Frankish. Report, Feb. 7, '90.

NOTE.—Above subject to corrections, under each Co., as reports indicate a connection between the two, or a possibility of the first supply water for domestic use only till second was in position to do so.

OROVILLE, *Butte Co.* (Pop., 1,743; est., 2,000.) On Feather river. Not incorp. No sewers or electric lights.

History.—Built in '78 by Oroville Water Co. No Engr. employed.

Water Supply.—West Branch of Feather river, by gravity through ditch to reservoir, supply being purchased from Thermalito Colony Co.

Reservoir.—Cap., 2,000,000 galls.

Distribution.—*Mains*, sheet iron, 5 miles. *Services*, w. i. *Taps*, 250. *Meters*, 2. *Hydrants*, Garratts, 42.

Consumption, 800,000 galls. *Pressure*, 70 lbs.

Financial.—Cost, $35,000. Cap. stock, $50,000. Ann. op. exp., $3,500. Ann. rev.: consumers, withheld, est., $7,000; city none. Hydrants, free.

Management.—Prest., Jno. J. Smith. Secy., E. W. Fogg. Supt., Sam'l Huston.

PACIFIC GROVE, *Monterey Co.* (Pop., not given.)

History.—Built in '83 by Pacific Improvement Co., Fourth and Townsend Sts., San Francisco, to supply Hotel del Monte, and incidentally Monterey, Pacific Grove and vicinity. Engr., Arthur Brown, West Oakland.

Water Supply.—Carmel river, by gravity to reservoirs.

Reservoirs.—Cap., 157,000,000 galls.; two, 140,000,000 and 17,000,000 galls, respectively.

Distribution.—(In '87.) *Mains*, 24 to 6-in. c. i., w. i., 26 miles. Contrs., Huntington Hopkins Co., San Francisco. *Services*, *Taps*, *Meters* and *Hydrants*, not given.

Consumption (in '87), 250,000 galls. *Pressure:* Ordinary, 85 lbs. Fire, 173 lbs.

Financial.—Withheld.

Management.—(In '88.) Prest., J. H. Strobridge. Secy. and Mgr., F. S. Douty, Fourth and Townsend Sts., San Francisco. Supt., I. A. Skinner.

NOTE.—No report for '89 could be obtained.

PASADENA, *Los Angeles Co.* (Pop., est., 9,000.) Incorp. Has sewers and electric lights.

NORTH PASADENA LAND AND WATER CO.

History.—Built in '69-71. Supplies pop. of 1,500.

Water Supply.—Arroyo Seco river, and branches to reservoirs.

Reservoirs.—Cap., 1,200,000 galls. *No.* 1: cap., 450,000 galls.; 50 x 100 ft., x 12 ft. deep. *No.* 2: cap., 750,000 galls.; 150 ft. sq., 10 ft. deep.

Distribution.—*Mains*, 12 to 4-in. c. i. and cem., 20 miles; from J. D. Hooker & Co., and Lacy, Ward & Co., Los Angeles. *Services*, not given. *Taps*, 300. *Meters*, 300 put in in '89. *Hydrants*, none.

Consumption, 150,000 galls. *Pressure*, 10 to 100-ft. head.

Financial.—Cost, $54,000. Cap. stock, authorized, $90,000; paid up (in '88), $54,000. Debt, $4,000. Int., 6%. Ann. op. exp., $2,500. Ann. rev.: consumers, $2,500; city, not given.

Management.—Prest., I. McCollum. Secy. and Treas., M. D. Painter. Supt., I. B. Lambert.

PASADENA LAND AND WATER CO.

History.—Built in '74, under 50-years franchise from '83. Supplies water to 2,500 of pop. of Pasadena and 1,000 of South Pasadena.

Water Supply.—Springs in the Arroyo Seco, by gravity and by pumping to reservoirs. Pumps used only in summer when higher sources of water run low.

Pumping Machinery.—Dy. cap., 792,000 galls.; Worthington comp.

Reservoirs.—Cap., 4,000,000 galls. *South Pasadena:* Cap., 1,000,000 galls.; area, 1 acre: in excavation and embankment. Inner slopes lined with 10 ins. of boulders, lime and cem. *Spillway:* runs through bank, lined with 10 ins. of boulders, lime and cem., controlled by gates; slope, very heavy. *Discharge-pipe:* 7-in.; slope 50 to 1. Reservoir does not leak. Built in '74. Cost, $5,000.

Orange Grove Reservoir: cap., 3,000,000 galls.; area, 3 acres. Similar in construction to above. *Discharge-pipe:* 11-in. Built in '71. Cost, $5,000.

Distribution.—*Mains*, c. i., w. i., 10 miles, from L. W. Dennis and Lacy, Ward & Co., both of Los Angeles, and R. Hentig & Co., Pasadena. *Taps*, 800. *Meters*, 12. *Hydrants*, 12.

Consumption, 500,000 galls. *Pressure*, 60 to 100-ft. head.

Financial.—Cost, $90,000. Cap. stock (in '88), $75,000. No debt. Ann. op. exp., $5,000. Ann. rev.: consumers, $6,000; city, none.

Management.—Prest., O. R. Dougherty. Secy., H. G. Bennett. Treas., S. Washburn. Supt., W. J. Barcus.

PASO ROBLES, *San Luis Obispo Co.* (Pop., est. 1,000.) Incorp. city. No sewers or electric lights.

History.—Built in '87-8 by Paso Robles Water Co.; put in operation, May, '88. Const. Engr., R. M. Shackelford.

Water Supply.—Springs, pumping to reservoir. No filtration.

Pumping Machinery.—Dy. cap., 580,000 galls.; Dow.

Reservoir.—Cap., 150,000 galls.; Contrs., Blackburn & James.

Distribution.—*Mains*, 6-in., 5 miles. *Taps*, 75. *Meters*, 10. *Hydrants*, 6.

Consumption, 50,000 galls. *Pressure:* Ordinary, 100 lbs. Fire, 126 lbs.

Financial.—Cost, $15,000. Cap. stock, authorized, $20,000; paid up, $16,000. No debt. Ann. op. exp., withheld, est., $1,500. Ann. rev: total, withheld, est., $2,500.

Management.—Prest., D. W. James. Secy., D. Speyer. Treas., Bank of Paso Robles. Supt., G. W. Garren. Report, Feb. 13, '90.

PETALUMA, *Sonoma Co.* (Pop., 3,326; est., 4,000.) On Petaluma creek, 10 miles from San Pablo bay in valley surrounded by hills. Has manufactories. Settled in '52; incorp. in '57. Has sewers. No electric lights.

History.—Built in '71 by Sonoma County Water Co. Des. Engrs., Thomas Bros. Contr., M. J. Miller.

Water Supply.—Mountain streams draining 20 sq. m., by gravity to reservoir.

Projected Dam and Reservoir.—To be built in '90, about 7 miles from town, for storage. Cap., 40,000,000 galls. Dam, of earth, riprapped on inside; clay heart-wall.

Conduit.—Of 7-in. riveted w. i. pipe, leading to reservoir.

Reservoir.—Cap., 2,500,000 galls.; originally 150 ft. sq.; rebuilt in '82, and enlarged to 110 x 210 ft., x 14 ft. deep, with 11 ft. of water, in excavation and embankment, 175 ft. above town. Embankment, 14 ft. high; of sandy clay. Inner slope, 1½ to 1, lined with masonry. Outer slope, 2 to 1, sodded. *Pipes:* influent, 8-in.; effluent and overflow. Reservoir does not leak. Des. Engr., Henry Bloomfield. Const. Engr., F. W. Lougee. Contr., W. Bear. Cost, $8,000.

Distribution.—*Mains*, c. i., riveted w. i., 17 miles. *Services*, w. i. *Taps*, 800. *Meters*, 4. *Hydrants*, Savage & Sons, 32. *Valves*, Chapman.

Consumption, 200,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 70 lbs.

Financial.—Cost $140,000. Cap. stock, $300,000. Bonded debt, $20,000. Int., 5%. Sinking fund, $5,000. Ann. op. exp., $4,752. Ann. rev.: consumers, $18,468; city, $1,336. Hydrant rental, $30.

Management.—Prest., H. E. Laurence. Supt. and Secy., F. P. Doyle.

PLACERVILLE, *Eldorado Co.* (Pop., 1,951; est., 2,200.) In gold mining region.

History.—Built by Co., date not given.

Water Supply.—Mining canal, by gravity to reservoirs.

Reservoirs.—Cap., 500,000 galls.; two.

Distribution.—(In '86.) *Mains*, 7 to 3-in., 3½ miles. *Hydrants*, 18.

Pressure: Ordinary, 47 lbs. Fire, 150 lbs.

Financial.—No data.

Management.—Address G. W. Barlow or Robt. Motzer.

NOTE.—No returns given for '88 or '89.

POMONA, *Los Angeles Co.* (Pop., est., 5,000.) Incorp. No sewers. Has electric lights.

History.—Built in '82-3 by Pomona Water-Works Co.

Water Supply.—Artesian well, by gravity. Dy. flow, 1,500,000 galls.

Distribution.—*Mains*, 30 miles; about 50 miles cem. pipe in addition, for irrigation. *Taps*, 730. *Meters*, none. *Hydrants*, 22.

Consumption, 500,000 galls. *Pressure*, 60 lbs.

Financial.—Cost, $100,000. Cap. stock, $250,000. Ann. op. exp., not given, est. $3,000. Ann. rev.: consumers, withheld, est., $15,000; city, none.

Management.—Prest., B. S. Nichols. Secy. and Treas., F. L. Palmer. Supt., H. J. Nichols.

PORTERVILLE, *Tulare Co.* (Pop., est., 600.) Not incorp. No sewers. Has electric lights.

History.—Built in '88 by Pioneer Land Co., San Francisco. Engr., Emil Newman, Porterville.

Water Supply.—Tule river, by gravity to pump, thence by pumping to standpipe and tank. Water is conveyed by gravity through ditch 8 miles in length, then filtered, and after passing to well is pumped to large air chamber connected with force main.

Ditch.—Cap., 72 cu. ft. per second; 3 ft. deep, 12 ft. wide. For first mile it is excavated in rock and has total fall of 15 ft.; thence it follows foot-hills, having fall of 1 ft. to 1,000. Soil is mostly adobe.

Filter.—Water first passes to well through bank, or layer of coarse gravel. From well it passes to filter proper, a box 3 x 5 ft., 16 ft. long, filed with alternate 2-ft. layers of charcoal and gravel. Gravel bank can be cleaned by reversing flow, but as filter-box slopes towards pumps cleaning is impossible, and filter clogs.

Pumping Machinery.—Dy. cap., 500,000 galls.; water-power pump, from J. B. Jardine, driven by 33-H. P. Leffel mining water-wheel.

Pump-Well.—Is 10 ft. in diam., 9 ft. deep; lined with brick laid in and plastered with cem.

Tank.—Cap., 30,000 galls.; built by Co.

Distribution.—*Mains*, 6-in. coated w. i., 2¼ miles. *Services*, w. i. *Taps*, 49. *Meters*, none. *Hydrants*, 7

Consumption, 18,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 70 lbs.

Financial.—Cost, $11,500. Cap. stock., $250,000. Ann. op. exp., $500. Ann. rev.: consumers, $1,300; city, none.

Management.—Prest., W. Thomas, 206 Sansome St. Secy., Louis Stoss, Jr., 310 Sansome St. Both of San Francisco. Supt., E. Newman.

RED BLUFF, *Tchama Co.* (Pop., 2,106; est., 3,500.) On terrace of red, gravelly loam, 60 ft. above Sacramento river. Settled in '50; incorp. city in '74. Has sewers and electric lights.

History.—A small system was built in '61 by a private Co., and present works in '80 by S. H. Jewett, Peter Decker and Chas. Cadwalader, and known as Antelope Creek & Red Bluff Water Co. There is no franchise. Built under direction of C. Cadwalader.

Water Supply.—Antelope creek, 9 miles distant, by gravity, and Sacramento river, by direct pumping. River water was originally pumped to settling basin, then repumped by Garrett pumps into 4 tanks with cap. of 45,000 to 55,000 galls. each, and to stand-pipe.

Stand Pipe.—Cap., 18,900 galls.; 8 x 50 ft.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Hooker. *Boiler:* 40-H. P.

Distribution.—*Mains*, riveted and lap-welded w. i., 18 miles. *Services*, galv. i. *Taps*, 450. *Meters*, none. *Hydrants*, 35.

Consumption, 700,000 galls. *Pressure:* Ordinary, 30 lbs. Fire, 40 lbs.

Financial.—Cost, $150,000. No stock, bonds or debt. Ann. op. exp., $4,000. Ann. rev.: consumers, $12,000; city, none. Hydrant rental, $18.

Management.—Prest. and Supt., Chas. Cadwalader. Secy., W. B. Cahoone.

REDDING, *Shasta Co.* (Pop., est., 3 000.) In mining and lumbering district. Incorp. Has sewers. Electric lights contemplated.

History.—Built by Redding Water Co., date not given, but prior to '88.

Water Supply.—Sacramento river, pumping to reservoir.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; four 3 x 12-in. plunger, water-power plunger pumps, 20,000 Worthington steam. *Water-wheel:* placed between two boats; 22 x 20 ft. breast, with 3-ft. buckets, making three revolutions per minute.

Force Main.—Is 6 ins. in diam., 1¼ miles long.

Reservoir.—Is 197 ft. above river.

Distribution.—*Mains*, material not given, 7¾ miles. *Services*, not given. *Taps*, 310. *Meters*, 2. *Hydrants*, 20.

Consumption, 300,000 galls. *Pressure*, 135 lbs.

Financial.—Cost, $42,000. No debt. Ann. op. exp., $2,000. Ann. rev.: consumers, $7,300; city, $420. Hydrant rental, est., $21.

Management.—Prest., Francis Smith. Secy., S. J. R. Gilbert. Supt., S. P. Fillman.

REDLANDS, *San Bernardino Co.* (Pop., est., 2,000.) Incorp. city. No sewers or electric lights.

REDLANDS, LUGONIA & CRAFTON DOMESTIC WATER CO.

History.—Built in '87-8. Engr., E. A. Tuttle.

Water Supply.—Bear Valley reservoir, Santa Ana river and Mill creek, by gravity, to and from distributing reservoir. The Co 's water rights are somewhat complicated, it owning directly rights in Mill creek and Santa Ana river and the Bear Valley reservoir, and indirectly in all these sources through its interest in the Redlands Water Co., Sunny Side Water Co., West Redlands Water Co., East Redlands Water Co. and Crafton Water Co.

Water Cos. holding Bear Valley Co. stock received, upon completion of dam, two certificates upon each share, each certificate entitling holder to continuous flow of 1-7 in. of water delivered anywhere upon line of Bear Valley Co.'s ditches. Redlands, Lugonia & Crafton Domestic Water Co. owns about 300 such certificates, and when it needs water from Bear Valley reservoir it informs Bear Valley Co., who let required amount from reservoir to Santa Ana river, and former Co. draws from the river, 18 miles distant.

Distributing Reservoir.—Cap., 6,000,000 galls.

Distribution.—*Mains*, 12 to 6-in. w. i., sheet i., 24 miles. *Services*, ¾-in. w. i. *Taps*, 300. *Meters*, none. *Hydrants*, kind not given, 8.

Consumption, 460,000 galls. *Pressure*, 100 lbs.

Financial.—Cost, $250,000; for works, $130,000; for water rights, $120,000. Cap. stock, $500,000; $350,000 paid up. No debt. Ann. op. exp., $3,500. Ann. rev.: consumers, $9,000; city, none.

Management.—Prest., Geo. A. Cook. Secy., Fulton G. Feraud. Supt., H. W. Allen.

BEAR VALLEY DAM AND RESERVOIR.

General Description.—Built by Bear Valley Co., construction beginning in '84. Engr., F. E. Brown. Cost, $75,000.

Dam.—Granite masonry in cem., granite quarried near by. See accompanying plan, section and elevation for dimensions.

An earth dam 6 ft. high was first built, 2½ miles above proposed dam, stopping flow of water and flooding 450 acres at a depth of 5 ft. As work on dam proper progressed water was let in against it to bring pressure to bear upon arch before cem. set very hard, and thus let the whole arch take its bearings and transmit pressure to mountains at its ends.

Further details and illustrations showing status of work at different stages of its construction, together with editorial comments, will be found in *Eng. News*, vol. XIX., pp. 271-2, 513-17. Also see vol. XXII., pp. 484-6, 512-13, for description of proposed raising of dam to height of 120 ft.; article is illustrated.

PLAN OF ARCH
Bear River
Overflow
Bear River
Road
Road
Road

Distribution.—*Mains*, 8 to 4-in., material not given. 4½ miles. *Services*, not given. *Taps*, 290. *Meters*, 31. *Hydrants*, 36. *Close of '81, approximately: Mains*, 4½ miles. *Taps*, 190. *Meters*, 1. *Hydrants*, 34.

Consumption, 80,000 galls. *Pressure*, not given.

Financial.—Cost (in '87), $25,000. Debt, $4,000. Int., 6%. Ann. op. exp., $2,400. Ann. rev.: consumers, $6,000. Rev. for '87, about $2,500.

Management.—Supt., Jas. Stalter.

RIVERSIDE, *San Bernardino Co.* (Pop., 1,358; est., 6,000.) On Santa Ana river. Incorp. Has sewers and electric lights.

History.—Water-works proper built in '86-7 by Riverside Water Co. Irrigating system established in '71 by same Co. Engr., G. O. Newman.

Water Supply.—Artesian wells, by gravity from receiving reservoir. Nine wells, with dy. flow of 345,000 galls. First two are 11 ins. in diam., 117 and 109 ft. deep; all located in "artesian lands" near San Bernardino, 8 miles from Riverside. Sunk and supply conducted to town by Riverside Improvement Co. Engr., E. Newman.

Receiving Reservoir.—Brick, 30 ft. in diam., 4 ft. deep, divided by weir over which water falls for aeration; about 150 ft. above town.

Supply Main.—Length, 8 miles; first 3 miles, 17-in. w. i., 3½ lbs. per sq. ft.; remaining distance, 16-in. w. i., 4½ lbs. per sq. ft. From J. D. Hooker, Los Angeles.

Distribution.—*Mains*, 16 to 8-in. w. i., 18 miles. *Taps*, 350. *Meters*, none. *Hydrants*, kind not given, 20.

Consumption, about 200,000 galls. *Pressure:* Ordinary, 50 lbs. Fire, 80 lbs.

Financial.—Cost, $300,000 for domestic and $450,000 for irrigating works. Cap stock, $300,000. Debt, $435,000: $335,000 in bonds at 6, $100,000 at 8%. Ann. op. exp., for both systems, $30,000. Ann. rev.: consumers, $32,000, mostly for irrigating works; city, $1,000. Hydrant rental, $20.

Management.—Prest., Jno. G. North. Secy., D. Carroll. Engr., G. O. Newman Supt., Francis Cuttle.

Irrigating System.—Supply, Warm creek, tributary of Santa Ana river, by gravity. From creek water is conveyed for 4,000 ft. through flume with cap. of 6,000 miners' inches (120 cu. ft. per second), flume crossing Santa Ana river at av. height of 25 ft. above river bottom; thence about 1½ miles through open canal, 12 ft. wide on bottom, bottom and sides paved with 1 ft. of rubble masonry; thence through masonry-lined tunnel, 3,700 ft. long; thence about 5 miles through masonry-lined canal to distributing ditches in Riverside. At E. Riverside canal drops 40 ft., and power is utilized to drive Victor turbine and dynamos of electric lighting plant for San Bernardino, Colton and Riverside.

SACRAMENTO, *Sacramento Co.* (Pop., 21,420; est., 35,000.) On level ground at junction of American and Sacramento rivers. City is about 8 ft. above ordinary high water. Settled in '39; incorp. city in '49. Has sewers and electric lights.

History.—Built in '54 by city.

Water Supply.—Sacramento river, pumping to tank and direct.

Pumping Machinery.—Dy. cap., 7,000,000 galls.; 3,000,000 Holly quadruplex, erected in '83, and 4,000,000 pump since designed and constructed by A. J. Stevens.

Tank.—Cap., 3,000,000 galls.; 81½ x 81½ ft.

Distribution.—(In '87.) *Mains*, c. i., w. i., 35 miles. *Services*, w. i. *Taps*, 4,600 *Meters*, none. *Hydrants*, 369.

Consumption, 6,000,000 galls. *Pressure:* Ordinary, 30 lbs. Fire, 60 lbs.

Financial.—(In '87.) Cost, $350,000. No debt reported. Ann. op. exp., $25,000. Ann. rev.: consumers, $68,500; city, $60,000.

Management.—Three Trustees. Supt., H. C. Wolf. Chf. Engr., E. H. Williams.

NOTE.—Report for '89 says "No changes."

SAINT HELENA, *Napa Co.* (Pop., 1,339; est., 2,500.) Has electric lights.

History.—Built in '77-8 by St. Helena Water Co.

Water Supply.—Spring, by gravity.

Reservoir.—Cap., 30,000,000 galls.

Distribution.—(In '87.) *Mains*, w. i., 5 miles. *Services*, w. i. *Taps*, 196. *Meters*, none. *Hydrants*, kind not given, 25.

Consumption, 200,000 galls. *Pressure*, 65 lbs.

Financial.—(In '87.) Cost, $40,912. Cap. stock, authorized, $50,000; paid up, $40,250. No bonds or debt. Ann. op. exp., $700. Ann. rev.: consumers, $4,200; city, $400. Hydrant rental, $12.

Management.—(In '88.) Prest., W. C. A Smith. Secy., F. S. Ewer. Supt. Seneca Ewer.

NOTE.—No report for '89 could be obtained.

SALINAS, *Monterey Co.* (Pop., 1,854; est., 3,500.) Settled in '63; incorp. city in '74. Has electric lights.

History.—Built in 74-'5 by Salinas Gas & Water Co. Engr., Jos. Enright, San Jose. Principal Contr., Wm. White, Portland, Ore.

Water Supply.—Four 10-in. artesian wells, pumping to tanks. Wells are 84, 87, 200 and 234 ft. deep, respectively.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Worthington comp., dup.

Tanks.—Cap., 130,000 galls.; three, two of 90,000 galls. cap. each at 45 ft. above city, and one of 40,000 galls. cap., at 75 ft. above city. Latter is for fire protection.

Distribution.—*Mains*, c. i., 7 miles. *Services*, w. i. *Taps*, 294. *Meters*, 2. *Hydrants*, Standard Olympia, 24.

Consumption. 200,000 galls. *Pressure:* Ordinary, 31 lbs. Fire, 40 lbs.

Financial.—Cost, $51,000. No debt. Ann. op. exp., $3,820. Ann. rev.: consumers, $5,500; city, $600.

Management.—Prest., J. B. Iverson. Secy., R. L. Porter. Supt., F. B. Day.

SAN ANDREAS, *Calaveras Co.* (Pop., est., 600.)

General Description.—Master & Wallace supply business houses of village by pumping to tanks, pumps being driven by windmill. Est. cost, $1,000.

SAN BERNARDINO, *San Bernardino Co.* (Pop., 1,673; est., 10,000.) Incorp. city. Has sewers and electric lights.

General Description.—City to begin construction about June 1, '90, and have works in operation Jan. 1, '91. Contracts for furnishing pipe and building conduit were let in Apr. Engr. and Supt., F. C. Finkle. Supply, artesian wells, by gravity. Reservoir, cap., 3,000,000 galls. Specifications call for 15,400 ft. 12-in. steel supply main, from reservoir to city, and about 17 miles 12 to 6-in. c. and kal i. pipe for distribution; also 70 hydrants. Pressure, 60 to 87 lbs. Est. cost, $160,000; to be met with 6% bonds. City Clerk, B. B. Harris. Address, F. C. Finkle. Report. Feb. 3, '90.

SAN DIEGO, *San Diego Co.* (Pop., 2,637; est., 25,500.) On San Diego bay surrounded by hilly country. Founded in '30; incorp. in '50. Has sewers and electric lights.

History.—Built in '73 by San Diego Water Co., formerly known as San Diego & Coronado Water Co. Des. Engr., H. M. Covert.

Water Supply.—San Diego river and 11 wells, pumping to reservoir. River has a drainage area of 40 sq. m. Wells are from 24 to 30 ft. in diam., and from 15 to 25 ft. deep.

Pumping Machinery.—Dy. cap., 6,500,000 galls; a 1,000,000 Worthington, a 2,000,000 Holly, a 3,000,000 Gaskill horizontal and a 500,000 Dow, latter added in '88, and working against a head of 500 ft. Formerly a Hooker of 8 in. bore and 42 in. stroke lifted water 220 ft.

Reservoir.—Cap., 3,850,000 galls.; two 3,000,000, one 850,000 galls., respectively.

Distribution.—*Mains*, riveted w. i., 54¾ miles. *Services*, w. i. *Taps*, 1,501. *Meters*, 1,000. *Hydrants*, 100.

Consumption, 1,200,000 galls.; 900,000 in summer, 1,500,000 in winter. *Pressure:* Ordinary, 45 lbs. Fire, 160 lbs.

Financial.—Cost, $710,000. Cap. stock (in '88), $125,000 subscribed for, $500,000 authorized. Debt, $296,000: $4,000 at 10, $25,000 at 8, $17,000 at 6, $250,000 in bonds, at 6%. Ann. op. exp., $31,000. Ann. rev: total, $110,434. Hydrant rental, $50.

Management.—Prest., E. S. Babcock, Jr. Treas., First National Bank, San Diego. Secy. and Supt., Joseph A. Flint.

SAN FRANCISCO, *San Francisco Co.* (Pop., 233,959; est., 250,000.) At end of peninsula 6 miles wide and 20 miles long, extending into San Francisco bay. In '81 its area was about 42 sq. m., including several islands, nearly half a high rocky hill, rising at points 800 ft. above sea. Quite extensive area of level land has been formed by grading, and by filling in bay. Settled in 1776 by Spanish; in '35 town called Yerba Buena was founded here, name being changed to San Francisco in '47, when pop. was 450. In '60, pop. was 56,000. Has sewers and electric lights.

History.—Built in '56-9; now owned by Spring Valley Water-Works Co. Supplies San Mateo.

In '57, San Francisco Water-Works Co. was organized, with cap. stock of $1,000,000, which in '64 was increased to $2,000,000. In June, '58, Spring Valley Water-Works

Co. was organized, with cap. stock of $60,000, increased in '60 to $3,000,000. Each Co. built works, and operated them until '65 when two were consolidated under present name, with cap. stock of $6,000,000. In '68 the cap. stock was increased to $8,000,000, and '76 to $16,000,000. Engr. for present Co., Hermann Schussler.

Water Supply.—Mountain streams, by gravity from impounding and storage, to distributing reservoirs, and Lobus creek and Lake Merced, by pumping to reservoirs.

Water was pumped temporarily (prior to '89) from lower Crystal Springs reservoir to Pilarcitos conduit. There are 4 storage and 8 distributing reservoirs, and 4 main conduits leading to city.

LOBUS CREEK PUMPING PLANT.

Mountain Lake.—On Lobus creek, impounding flow from drainage area of 2½ sq. m. Water is mainly from percolation through sand.

Conduit.—Partly of wood and partly of masonry, extending 23,700 ft. to Black Point, at zero elevation, from which it is pumped.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Worthington; at first there were two cond. engines with 40-in. cylinder and 48-in. stroke, driving two pumps, one of 14-in. bore, 84-in. stroke, and 3,500,000 galls. cap., the other of 12-in. bore, 6 -in. stroke, and 2,500,000 galls. cap., now rated as above. These pumps lifted water to Lombard and Francisco street reservoirs, described below. Only smaller of these pumps is now used here.

LAKE MERCED PUMPING PLANT.

Lake Merced.—No data.

Pumping Machinery.—Dy. cap., 8,000,000 galls.

Conduit.—Connects with conduit from San Andreas storage reservoir.

PILARCITOS CREEK SUPPLY.

Dam and Reservoir.—*Dam:* of earth, 640 ft. long, 95 ft. high, 26 ft. wide on top, with slopes of 2¾ and 2¼ to 1. Trench was dug below bottom of dam to solid rock, 26 ft., and filled with puddle. After reservoir was filled, leak appeared, caused by unsound rock foundation; shaft was sunk through bank for 80 ft. bad rock removed, and space filled with puddle. This made dam tight. *Reservoir:* cap., 1,080,000,000 galls.; is 46 ft. deep, its water surface is at elevation of 696 ft.; av. yearly rainfall at this point is 49.7 ins. Reservoir is on Pilarcitos creek, 15 miles from San Francisco, and was built in '64. Drainage area of creek is 3¾ sq. m., and drainage of additional area of about 2 sq. m. is brought through flume into reservoir by intercepting the water of several streams, naturally emptying into creek below dam. *Flume:* about 5 miles long, with cross-section of 16 x 42 ins.

Conduit.—Partly wooden flume and partly 30-in. w. i. pipe, for 13 miles to Lake Honda, and thence by 10-in. pipe to Lombard street reservoir.

SAN ANDREAS SUPPLY.

Source.—Lock's and San Mateo creeks, and Pilarcitos creek below Pilarcitos reservoir.

Gathering Conduits.—Water from Lock's creek is conveyed to reservoir from elevation of 505 ft. through wooden flume, w. i. pipe and masonry-lined tunnels, distance being 17.42 miles. Water from San Mateo and Pilarcitos creeks is also brought to reservoir through flumes and pipes.

Dam and Reservoir.—*Dam:* of earth, 640 ft. long, 93 ft. high, and 25 ft. wide on top; trench was dug below bottom of the dam, 47 ft., to rock, and filled with puddle. *Reservoir:* cap., 7,000,000,000 galls.; 89 ft. deep, with water surface at elevation of 455 ft. Receives drainage from 10.81 sq. m. Av. yearly rainfall at this point is 44.75 ins.

Conduit.—Of 32 and 22-in. w. i, 12.1 miles long, ending at College hill distributing reservoir.

CRYSTAL SPRINGS SUPPLY.

San Mateo Dam and Reservoir.—Dam of concrete, 400 long on top, 172 ft. at bottom, 115 ft. high, 60 ft. wide at top, 176 at bottom; carried to bed-rock foundation, said to be 100 ft. below surface; arch type, with radius of 835 ft. Concrete laid in blocks about 30 x 30 ft., x 10 ft. thick. When completed as designed dam will be 170 ft. high, 25 ft. wide on top. *Reservoir:* cap. at above height, about 10,000,000,000 galls.; at projected height, about 31,000,000,000 galls. Water is backed up for 9 miles, forming 3 lakes, known as San Andreas, Canada Romulda and Crystal Springs. Elevation of water at regulating gate, 250 ft. above bay. For further details and illustrations see *Eng. News*, vol. XXI., pp. 182-3.

Conduit.—Before reservoir was completed plan was for 21 miles of 40-in. iron pipe. It is not stated whether this plan was carried out.

Old Pumping Machinery.—Dy. cap., 3,500,000 galls.; formerly lifted water from reservoir to Pilarcitos conduit; no longer in use.

CALAVERAS SUPPLY.

Source.—Calaveras creek, Arroyo Hondo and Arroyo Valle, having drainage area of 100, 40 and 110 sq. m., respectively, all gathered in Calaveras reservoir. First two creeks discharge into reservoir naturally, while aqueduct about 5 miles long was constructed to bring in water from latter.

Reservoir.—Cap., 30,351,000,000 galls.; has a depth of 183 ft., surface elevation of 745 ft., and receives drainage from 250 sq. m.; av. yearly rainfall in this section is 40 ins.

Conduit.—Length not given; 37-in., connecting with Crystal Springs conduit few miles from city. It crosses upper end of San Francisco bay by two 16-in. pipes.

DISTRIBUTING RESERVOIRS.

Lower Service.—Takes about one-half the supply.

Lower Russian Hill: cap., 6,712,000 galls.; 14 ft. deep; surface elevation, 139 ft. Filled by Pilarcitos conduit and Lobos creek pump.

Brannan Street: cap., 400,000 galls.; 8 ft. deep; surface elevation, 85 ft.

Middle Service.—Takes about one-sixth of supply.

College Hill: cap., 15,006,000 galls.; 15 ft. deep; surface elevation, 252 sq. ft. Filled by San Andreas conduit.

Market Street: cap., 2,250,000 galls.; 15 ft. deep; surface elevation, 196 ft.

Upper Service.—Takes about one third of supply by Pilarcitos conduit.

Lake Honda: cap., 32,918,000 galls.; 29 ft. deep; surface elevation, 377 ft. Filled by Pilarcitos conduit.

Upper Russian Hill: cap., 3,724,000 galls.; 22 ft. deep; surface elevation, 306 ft. Filled from Pilarcitos conduit and Lobus creek pump.

Clay Street Reservoir or Tank: cap., 141,000 galls.; circular, 9 ft. deep; surface elevation, 375 ft.

Total cap., 61,151,000 galls.

Distribution.—*Mains*, c. i., w. i., 326 miles. *Services*, lead. *Taps*, 30,000. *Meters*, 12,750. *Hydrants*, "all kinds," 1,570.

Consumption, 18,241,000 galls. *Pressure*, 60 lbs.

Financial.—(In '87.) Cost, $17,000,000. Debt, $5,000,000. Int., 5%. Ann. op. exp., about $800,000. Ann. rev.: total, $1,375,000; city, none in '86. Hydrant rental, $30.

Management.—Prest., Chas. Webb Howard. Secy., Wm. Norris. Chf. Engr., Hermann Schussler. City Supt., Chas. Elliot.

SAN GABRIEL, *Los Angeles Co.* (Pop., est., 500.)

General Description.—Built by San Gabriel Valley Land & Water Co., date not given, but prior to Oct., '89; principally for domestic use. Supply, flowing artesian wells and irrigating ditches. Prest., H. H. Markham. Secy., A. L. Burbank. Report, Oct. 17, '89.

SAN JOSE, *Santa Clara Co.* (Pop., 12,567; est., 20,000.) On Los Gatos creek. Settled in '48; incorp. in '51. Has electric lights.

History.—Built in '65 by San Jose Water Co. Const. Engr., Alex. W. Hess. Contr., M. Chabot. System includes supply of Santa Clara.

Water Supply.—Mountain streams, by gravity from impounding to distributing reservoirs, and 7 artesian wells, by pumping for about 5 months, to supplement gravity supply.

Impounding Reservoirs.—Cap., 150,000,000 galls.; three, first two having areas of 22 and 12 acres, respectively.

Conduits.—Wooden flumes and concrete pipe, extending from impounding to distributing reservoirs, about 10 miles.

Distributing Reservoirs.—Cap., 8,000,000 galls.; 3, first having cap. of 2,000,000 galls., at 70 ft. above town. Others not described.

Pumping Machinery.—Dy. cap., 2,850,000 galls.; Knowles comp. and 850,000 Dow, latter added in '87.

Distribution.—(In '87.) *Mains*, c. i., riveted, w. i., 65 miles. *Taps*, about 3,500. *Meters* (in '84), 13. *Hydrants*, 200.

Consumption (in '87), 3,000,000 galls. *Pressure:* Ordinary, 20 lbs. Fire, 40 lbs.

Financial.—(In '87.) Cost, $500,000. Cap. stock, $700,000. Debt, $50,000. Int., 6%. Ann. op. exp., withheld, est., $15,000. Ann. rev.: consumers, withheld, est., $105,000; city, not given.

Management.—Prest., E. Williams. Supt., Wilbur Wilcox.

NOTE.—No report for '89 could be obtained.

SAN LEANDRO, *Alameda Co.* (Pop., 1,369.) Supplied by Contra Costa Water Co., Oakland, which see.

SAN LUIS OBISPO, *San Luis Obispo Co.* (Pop., 2,243; est., 3,500.) Incorp. in '74. No sewers. Has electric lights.

History.—Built in '74 by San Luis Water Co., under exclusive franchise.

Water Supply.—San Luis creek, by gravity.

Dam and Impounding Reservoir.—Cap., 20,000,000 galls. Dam not described.

Distributing Reservoir.—Cap., 1,500,000 galls.; in excavation and embankment; 150 ft. above and two miles from town.

Distribution.—*Mains*, c. i., 10 miles. *Services*, not given. *Taps*, 475. *Meters*, none. *Hydrants*, San José, 22.

Consumption, 300,000 galls. *Pressure*, 150-ft. head.

Financial.—Cost, $100,000. Cap. stock and bonds, $60,000. No debt. Ann. op. exp., withheld, est., $2,000. Ann. rev.: consumers, withheld, est., $10,000. Hydrants free.

Management.—Prest., J. P. Andrews. Secy. and Supt., Jno. A. Nock.

SAN MATEO, *San Mateo Co.* (Pop., 932.)

General Description.—Supplied by gravity from Spring Valley Water Co., San Francisco. Address Chf. Engr., Hermann Schussler, San Francisco, or W. H. Lawrence, San Mateo. No other information given.

SAN PEDRO, *Los Angeles Co.* See Wilmington and San Pedro.

SAN RAFAEL, *Marion Co.* (Pop., 2,276; est., 3,000.) On San Pablo straits. Incorp. Has sewers and electric lights.

History.—Built in '71 by Marion County Water Co.

Water Supply.—Mountain lake, with area of 22 acres, by gravity.

Conduit.—Of wood, 16 x 12 ins., 1,500 ft. long. Built to connect with first reservoir.

Reservoirs.—Cap., 11,000,000 galls.; two, having cap. of 3,000,000 and 8,000,000 galls., respectively; first is 150 ft. above town.

Distribution.—*Mains*, c. i., w. i., 40 miles. *Services*, w. i. *Taps*, 630. *Meters*, 40. *Hydrants*, 40. *Valves*, Eddy.

Consumption, not given. *Pressure:* Ordinary, 80 lbs. Fire, 100 lbs.

Financial.—Cost, $435,000. Cap. stock, $600,000. Bonded debt, $135,000. Int., 5%. Ann. op. exp. (in '87), $2,500. Ann. rev. (in '87): consumers, $34,000; city, $900. No hydrant rental.

Management.—Prest. and Supt., R. Walker. Secy., H. R. Catton.

SANTA BARBARA, *Santa Barbara Co.* (Pop., 3,640; est., 8,000.) At southeast end of valley 2 miles wide and 5 miles long. Mission creek passes through city, but it is dry except in rainy season. Settled about 1780; incorp. city in '74. Has sewers and electric lights.

SANTA BARBARA WATER CO.

History.—Formed Jan. 1, '89 by consolidation of Mission and De la Guerra Garden Springs Co.

MISSION WATER CO.'S WORKS.

History.—Built in '30 by Franciscan monks, and extended by present Co. in 73. they having bought works, date not given, for $20,000. Jan. 1, '89, the De la Guerra Garden Springs Water Co. was consol dated with this Co., now known as Santa Barbara Water Co. Des. Engr., for extensions, Hermann Schussler, San Francisco. Const. Engrs., R. B. & A. W. Canfield, Santa Barbara.

Water Supply.—Mission creek, by gravity

Impounding Dam.—Stone in cem., 100 ft. long, 16 ft. high and 16 ft. thick.

Conduit.—A 6-in. iron-stone pipe extends from dam to reservoir, 10,000 ft. Originally this was an open ditch, lined with stone in cem. In '73 a V shaped wooden flume was substituted, with sides 12 ins. wide, laid on a grade of 2¼ ft. per 100. Later, changed as above.

Reservoir.—Cap., 750,000 galls.; 110 ft. sq., x 10 ft. deep. Walls are of stone in cem., vertical on inner face, 15 ft. thick, for 4 ft. from bottom, and 3 ft. thick at top. Water surface is 300 ft. above city.

DE LA GUERRA GARDEN SPRINGS WATER CO.'S WORKS.

History.—Built in '88. Engr., W. R. Coats, Kalamazoo, Mich. Jan. 1, '89, these works were consolidated with Mission Water Co.'s works.

Data under Distribution, Financial and *Management* include both systems.

Water Supply.—Surface well, by direct pumping. Well is 30 ft. in diam., about 36 ft. deep, and yields about 1,000,000 galls. a day. It was sunk through from 17 to 26 ft. of muck, and 15 to 6 ft. of hardpan and blue clay to gravel stratum 2½ ft. thick. Inside main well are two driven wells, one 8 ins. in diam., 160 ft. deep, other 2 ins. in diam., 190 ft. deep.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Worthington comp.

The remaining data applies to the combined, or Santa Barbara Water Co.'s works.

Distribution.—*Mains*, c. i., riveted and welded, 14 miles. *Services*, galv. i. *Taps*, 600. *Meters*, none. *Hydrants*, 30.

Consumption, 500,000 galls. *Pressure*, 60 lbs.

Financial.—Cost, $235,000. Cap. stock (in '87), $120,000. Debt, $25,000. Int., 6%. Ann. op. exp., $5,000. Ann. rev.: consumers, $19,000; city, not given.

To Dec., '81, works had cost $50,586, and gross receipts had been $55,548.

Management.—Prest., R. B. Canfield. Secy., J. L. Hurlbut. Supt., A. W. Canfield.

SANTA CLARA, *Santa Clara Co.* (Pop., 2,416; est., 3,000.) See San José.

SANTA CRUZ, *Santa Cruz Co.* (Pop., 3,898; est., 6,500.) On San Lorenzo river and Monterey bay. Business part of city on flat ground, and residence section on elevated plateau. Manufactures lumber, leather, powder, paper and lime. Summer resort. Settled in 1719; incorp. city in '56. Has sewers and electric lights.

History.—Built in '76 by Santa Cruz Water Co. Engr., Edgar M. Morgan, deceased. In '88 or '89 works were sold to F. A. Hihn, who owned an independent plant, and the two have been consolidated. City is negotiating to purchase works, but cannot agree with Co. as to price. It has voted $300,000 for construction of new works, but May 20, '89 was having trouble in finding water. Unofficially reported, latter part of '89, that city had let contract for new works.

Water Supply.—Branciforte and Major's creeks, by gravity to reservoirs. First creek is east and second west of city, with distributing reservoir for each.

Reservoirs.—*Old:* cap., 650,000 galls.; 100 ft. above city, excavated in chalk rock, and lined with 3-ft. rubble masonry walls. *New:* cap., 5,000,000 galls., under construction.

Distribution.—*Mains*, riveted w. i., 35 miles; wood pipe was first used, but was not satisfactory. *Services*, w. i. *Taps*, 1,700. *Meters*, none. *Hydrants*, Garrett, 50. *Valves*, Eddy.

Consumption, 600,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 120 lbs.

Financial.—Cost, $230,000. Cap. stock (in '87) $100,000. No debt. Ann. op. exp., $6,000. Ann. rev.: consumers, $20,000; city, $1,500, for street sprinkling. Hydrants free.

Management.—Prest., W. H. Duke. Secy., Aug. C. Hihn. Treas., F. O. Hihn. Supt., A. Cappelman.

SANTA ROSA, *Sonoma Co.* (Pop., 3,616; est., 7,000.) On Santa Rosa creek in a valley 10 miles wide, between high mountains. Settled in '52; incorp. city in '67. Has sewers and electric lights.

History.—Built in '73 by Santa Rosa Water Co., under 50-years franchise. Engr., Preston Davis.

Water Supply.—Santa Rosa and Alamos creeks, by gravity.

Dam and Reservoir.—Cap., 150,000,000 galls.; area, 23 acres; depth, 24 ft.; 80 ft. above, two miles from, city. Dam, of concrete, 100 ft. long, 8 ft. thick, built across mouth of canyon.

Another reservoir is reported but not described, and the building of a third was projected in '89.

Supply Main.—Of 15-in. riveted w. i., leading two miles to city.

Distribution.—*Mains*, w. i. (in '87), 15 miles. *Services*, w. i. *Taps* (in '86), 800. *Meters*, 2. *Hydrants*, 29.

Consumption, unknown. *Pressure:* Ordinary, 25 lbs. Fire, 86 lbs.

Financial.—Cost (in '87), $150,000. Cap. stock, $50,000. No bonds. Debt, about $3,000. Int., 6%. Ann. op. exp., $5,000. Ann. rev.: consumers, $18,339; city, $100.

Management.—Prest. and Supt., Mark L. M. Donald. Secy., T. A. Proctor.

SELMA, *Fresno Co.* (Pop., est., 3,000.) Has flour mills and lumber yards. Not incorp. No sewers or electric lights.

History.—June 30, '89, two private plants were destroyed or injured by fire. Later, Selma Water Co. purchased these, taking possession Jan. 1, '90, a new tank having been built meanwhile.

Water Supply.—Artesian well, 180 ft. deep, pumping to tank. No filtration.

Pumping Machinery.—Dy. cap., 300,000 galls.; Hooker, Dow.

Tank.—Cap., 55,000 galls.; on 60-ft. tower.

Distribution.—*Mains*, 3½ miles; from W. W. Montague and W. T. Garratt & Co.; trenching and pipe-laying done by the day. *Taps*, 450. *Meters*, none. *Hydrants*, Garratt's, 7.

Consumption.—Summer, 200,000 galls.; winter, 20,000 galls. *Pressure:* Ordinary, 30 lbs. Fire, 180 lbs.

Financial.—Cost, $12,500. Cap. stock, authorized, $25,000; paid up, $12,500. Ann. op. exp., $1,500. Ann. rev.: consumers, $3,500; city, none. Hydrant rental, free.

Management.—Prest., D. S. Snodgrass. Secy., Frank Couch. Treas., Bank of Selma. Supt., J. W. Givens. Report, Feb. 12, '89.

SONORA, *Tuolumne Co.* (Pop., 1,492; est., 2,000.) On Woods creek. Incorp. No sewers or electric lights.

History.—Built in '53 by Gold Mount Water Co. Const. Engr., W. S. Cooper.

Water Supply.—Springs, by gravity to reservoir, thence repumped to another reservoir. Supply was increased in '89, by laying two miles of 6 and 4-in. pipe to additional spring, at cost of $7,000.

Pumping Machinery.—Dy cap., not given; an 8-in. double-acting water-power pump of 20-in. stroke.

Reservoirs.—Cap., 270,000 galls.; two, having cap. of 150,000 and 120,000 galls., respectively.

Distribution.—*Mains*, 4 and 3-in. c. i., 3 miles. *Services*, not given. *Taps*, 300. *Meters*, none. *Hydrants*, 31.

Consumption, 500,000 galls. *Pressure*, 150-ft. head.

Financial.—Cost, $50,000. Cap. stock (in '87), $25,000. Debt, $9,000. Int., 6%. Ann. op. exp., $1,800. Ann. rev.: consumers, $4,000; city (in '87), $200.

Management.—Prest., Treas. and Supt., Jno. Ferguson. Secy., Mrs. Jno. Ferguson.

STOCKTON, *San Joaquin Co.* (Pop., 10,282; est., 16,000.) On level ground three miles from San Joaquin river, with which it is connected by navigable channel. Settled in '48; incorp. city in '50. No sewers. Has electric lights.

History.—Owned by Stockton Water-Works Co. In '57 P. E. Connor built works, which are now owned by above Co., their franchise running for 20 years. In '84 the works were extended.

Water Supply.—Artesian wells, pumping to reservoir, stand-pipe and tanks. Three of the wells are 975, 1,070 and 1,081 ft. deep, respectively, third flowing directly into reservoir. There are 60 small wells, 20 of them added in '89.

Pumping Machinery.—Dy. cap., 4,500,000 galls.: one 1,500,000 Risden and one 3,000,000 Worthington. [In '83 Blake, Cameron and Hooker pumps, one each, were in use. These may have been for pumping from wells to reservoir, and may still be in use, though not described in report for '88.]

Reservoir.—Cap., not given; 140 x 200 ft., x 8 ft. deep.

Stand-Pipe.—Is 3 x 75 ft.; of plate-iron.

Tanks.—Cap., 100,000 galls.; two of equal cap.; of wood; 80 ft. above city. In '83 an iron tank was reported as in use.

Distribution.—*Mains*, c. i., 8 miles. *Services*, w. i. *Taps*, 750. *Meters*, none. *Hydrants*, none.

Consumption, 1,000,000 galls. *Pressure*, 34 lbs.

Financial.—Cost, withheld. est., $110,000. Cap. stock (in '83), $100,000. No further figures given, but est.: Ann. op. exp., $5,000. Ann. rev.: consumers, $19,500.

Management.—Prest., H. O. Southwick. Secy. and Supt., M. S. Thresher.

SUTTER CREEK, *Amador Co.* (Pop., 1,324.)

General Description.—Owned by Blue Lakes Water Co.; formerly Amador Canal and Mining Co. Has storage reservoirs, main canal and branches, and supplies water to several town water companies, and principally motive power to quartz mines and mills.

TEMPLETON, *San Luis Obispo Co.* (Pop., est., 600.) Not incorp. No sewers or electric lights.

History.—Built in '87 by Templeton Water Co. Engr., R. M. Shackleford.

Water Supply.—Well, pumping to tank.

Pumping Machinery.—Dy. cap., 300,000 galls.; Dow.

Tank.—Cap., 40,000 galls.

Distribution.—*Mains*, 4-in. galv. i., 2 miles. *Services*, ¾ and ½-in. *Taps*, 50. *Meters*, 1. *Hydrants*, 6.

Consumption, 6,000 galls. *Pressure*, 45 lbs.

Financial.—Cost, $8,000. Cap. stock, $5,000. No debt. Ann. op. exp., $800. Ann. rev.: consumers, $900; city, none.

Management.—Mgr. and Supt., V. E. Donelson. Treas., C. M. Steinbeck.

THERMALITO COLONY, *Oroville, Butte Co.* (Pop., est., 3,000.) Not incorp. No sewers or electric lights.

History.—Built in '87-8 by Thermalito Colony Co., principally for irrigating purposes. Const Engr, Thomas Kelley.

Water Supply.—West branch of Feather river, by gravity to reservoir.

Reservoirs.—Cap., 20,000,000 galls.

Distribution.—*Mains*, 30 to 2-in., 11½ miles, from Brock & Taber. *Services*, not given. *Taps*, 415. *Meters*, none. *Hydrants*, none.

Consumption, 4,000,000 galls. in summer; 1,000,000 galls. in winter. *Pressure*, 160 ft. head.

Financial.—Cost, $250,000. Cap. stock, $1,000,000. Debt, $75,000. Int., 7%. Ann. op. exp., $3,000. Ann. rev.: consumers, withheld, est., $10,000; city, withheld.

Management.—Prest. and Supt., A. F. Jones. Secy., H. C. Hill. Treas., E. W. Fogg. Supt., Ed. Harkness.

NOTE.—Report also states that water used by Oroville Water Co. is supplied by this Co.

TRUCKEE, *Nevada Co.* (Pop., 1,147; est., 2,000.) On Truckee river. Incorp. Has sewers and electric lights.

History.—Built in '68, and now owned by Geo. Schaffer.

Water Supply.—Springs, by gravity.

Tank.—Cap., 337,500 galls.; 50 x 150 ft., x 6 ft. deep.

Distribution.—*Mains*, 11 and 7-in., 1 mile. *Services* and *Taps*, not given. *Meters*, none. *Hydrants*, 15.

Consumption, not given. *Pressure*, 90 ft. head.

Financial.—Cost, about $4,000. No debt. Ann. op. exp., $600. Ann. rev.: consumers (in '87), $2,000; city, none. Hydrants, free.

Management.—Owner, Geo. Schaffer. Secy., Ben Love. Supt., C. Shields.

TULARE, *Tulare Co.* (Pop. of township, 802; est., 2,500.) Incorp. No sewers. Has electric lights.

History.—Built in '82 by Tulare City Water Co., under a 50-years franchise. Des. Engr., T. J. Flannigan. Const. Eng., D. W. Madden, Tulare.

Water Supply.—Two artesian wells, 400 ft. deep, pumping direct and to tanks. Two additional wells, 500 ft. deep, added in '89.

Pumping Machinery.—Dy. cap., 2,304,000 galls.; two 75,000 Hooker and one Buffalo; latter added in '89. *Boiler:* 50-H. P., added in '89.

Tank.—Cap., 100,000 galls.; of wood.

Distribution.—*Mains*, iron, 10¼ miles. *Services*, brass. *Taps*, 335. *Meters*, 1, *Hydrants*, kind not given, 25.

Consumption, 250,000 galls. *Pressure:* Ordinary, 37 lbs. Fire, 60 lbs.

Financial.—Cost, $62,569. Cap. stock, $100,063. No bonds or debt. Ann. op. exp., $5,718. Ann. rev.: consumers, $10,063. Hydrant rental was to be paid after July 1, '89.

Management.—Prest. and Supt., D. W. Madden. Secy., E. A. Braley.

VALLEJO, *Solano Co.* (Pop., 5,987; est., 5,000.) On straits of Carquinas on San Pablo bay, in rolling country. Settled in '52. Incorp. Has sewers and electric lights.

History.—Built in '69-70 by Vallejo Water Co. Des. Engr., Hermann Schussler San Francisco. Labor done by Co.

Water Supply.—Artificial lake, formed by dam, by gravity, and by pumping from supply mains to reservoir and stand-pipe.

Dam and Artificial Lake.—Area, 160 acres; drainage area, 10 sq. m.; 3 miles N. E. of city. Dam, of earth, 300 ft. long, 40 ft. high; originally planned to be 70 ft. high.

Supply Main.—Of 12-in. c. i., about 3 miles long.

Pumping Machinery.—Dy. cap., 500,000 galls.; two 250,000 Hooker.

Distributing Reservoir.—Cap., 500,000 galls.; in excavation; 150 ft. above tide level.

Stand-Pipe.—Cap., not given; of w. i.

Distribution.—*Mains*, c. i., 24 miles; w. i. was first used, but it only lasted from 6 to 8 years. *Services*, w. i. *Taps*, 1,020. *Meters*, 150. *Hydrants*, 50.

Consumption, 1,000,000 galls. *Pressure*, from 0 to 75 lbs.

Financial.—Cost, $300,000. Bonded debt, $185,000. Int., 5%. Ann. op. exp., withheld, est., $3,000. Ann. rev.: consumers, withheld, est., $35,000; city, none. Hydrants free.

Management.—Prest., S. E. Hillman. Secy. and Gen. Mgr., G. W. Wilson.

VALLEY SPRINGS, *Calaveras Co.* (Pop., 1,685.) Not incorp. No sewers or electric lights.

History.—Built in '84-5 by Thomas Hague. Eng., F. H. Reed.

Water Supply.—Mokelumne river, by gravity to reservoir, through ditch 4 miles long.

Reservoir.—Cap., 120,000 galls.

Distribution.—*Mains*, 3 and 4-in., ½ mile. *Taps*, 20. No meters or hydrants.

Financial.—Cost, $3,000. No debt. Ann. op. exp., $400. Ann. rev.: total, $650.

Management.—(In '88.) Owner, Thomas Hague, 2,228 Front St., San Francisco. Supt., H. A. Mensinger.

NOTE.—In '88 owner proposed bringing water from springs 1¾ miles from town. No report for '89 could be obtained.

VENTURA, *Ventura Co.* (Pop., 1,673; est., 3,500.) At mouth of San Buenaventura river, on Pacific ocean. Health resort. Settled in 1780; incorp. village in '70. Incorp. Has sewers. No electric lights.

History.—Built in '82 by Santa Ana Water Co., under 50-years franchise. Des. Engr., E. F. Hare. Town council fixes rents from consumers yearly.

Water Supply.—San Buenaventura river, by gravity through open ditch to reservoirs, with pumping for few houses on high ground. River falls 50 ft. to mile.

Reservoirs.—There are five, four of which have a cap. of 80,000, 240,000, 500,000 and 900,000 galls., respectively; none are over 120 ft. in diam., 12 ft. deep; all built on nearly level ground, in excavation and embankment; one-half depth is excavated, earth taken out forming embankment which was settled by filling reservoirs with water for few days, before paving. Inner slope, 1 to 1, walled with cobblestone, laid in puddle and coated with asphalt. First reservoir was built in '77; last, in '89.

Conduit.—A 10-in. w. i. pipe.

Pumping Machinery.—Dy. cap., 360,000 galls.; Worthington dup. *Boiler:* 20-H. P.

Distribution.—*Mains*, c. i., w. i., 17.1 miles. *Services*, galv. i. *Taps*, 634. *Meters*, 1. *Hydrants*, kind not given, 2. *Valves*, Eddy.

Consumption (in '87), 1,190 000 galls. *Pressure:* Ordinary, 47 lbs. Fire, 90 lbs.

Financial.—Cost, $152,646. Cap. stock, $100,000. Bonded debt, $50,000. Int., 6%. Ann. op. exp., $5,582. Ann. rev.: consumers, $9,758.

Management.—Prest. G. W. Chrisman. Supt. and Secy., E. P. Foster.

VISALIA, *Tulare Co.* (Pop., 1,412; est., 3,500.) On Kaweah river, 18 miles northeast of Tulare lake. Engaged in mining. Has electric lights.

History.—Built in '77 by W. H. Hammond, under 20-years franchise. Des. Engr., D. B. Jones. Const. Engr., J. M. Fox. Sub-contrs., Fox & Wilde. All of Visalia.

Water Supply.—Artesian wells, pumping to tanks and direct.

Pumping Machinery.—Dy. cap., 840,000 galls.; one 360,000 Blake, and two 240,000 Hooker, from H. P. Gregory, San Francisco.

Tanks.—Cap., 38,000: 20,000 and 18,000 galls. respectively; from Fox & Wilde. A 40,000-gall. tank was to be added in '88.

Distribution.—(In '87.) *Mains*, material not given, 5 miles; from Dunham, Carrigan & Co., San Francisco. *Services*, 2-in. w. i. *Taps*, not given. *Meters*, none. *Hydrants*, from Dunham, Carrigan & Co., 12.

Consumption, 200,000 galls. *Pressure*, not given.

Financial.—(In '87.) Cost, $30,000. Debt, $10,000. Int., 7%. Ann. op. exp., $3,120. Ann. rev.: consumers, $6,270; city, $450.

Management (in '88).—Owner, W. H. Hammond. Supt., C. E. Bliss.

NOTE.—No report for '89 could be obtained.

WATSONVILLE, *Santa Cruz Co.* (Pop., 1,799; est., 3,000.) On level ground on Pa Jaro river. Settled in '52; incorp. town in '68.

History.—Built in '76-8 by Corralitos Water Co. Engr., J. B. Culver. Labor done by Co.

Water Supply.—Corralitos creek, 7 miles distant; by gravity to reservoirs.

Reservoirs.—Cap., 2,000,000 and 800,000 galls., respectively. First is in excavation, in hard clay, 125 x 175 ft., 90 ft. deep, above and two miles from, town.

Supply Main.—In '83 an 8-in. riveted w. i. pipe led from first reservoir to town, 2 miles.

Conduit.—Of redwood, 12 x 15 ins., extending 8 miles to reservoirs.

Distribution.—(In '87.) *Mains*, riveted, w. i., 8 miles. *Services*, w. i. *Taps*, 450. *Meters*, none. *Hydrants*, kind not given, 22.

Consumption, not given. *Pressure*, 35 lbs.

Financial.—(In '87.) Cost, $120,000. Cap. stock, $100,000. No bonds or debt. Ann. op. exp., $2,000. Ann. rev.: consumers, $7,500; city, $600 for street sprinkling and hydrants.

Management.—(In '88.) Supt., A. White. Most, or all, of stock is owned by Francis Smith & W. W. Montague, 130 Beale St., San Francisco. Main offices of Co. are at this address.

NOTE.—No report for '89 could be obtained.

WEST BERKELEY, *Alameda Co.* (Pop., 2,000; est., 4,000.)

History.—Built about '75; now owned by Alameda Water Co. No Engr. employed.

Water Supply.—Tunnels driven into hills, and springs by gravity.

Reservoirs.—Cap., 3,000,000 and about 8,000,000 galls., respectively.

Distribution.—*Mains*, black w. i. *Services*, do., and galv. i. *Taps*, 500 or 600. *Hydrants*, 30.

Management.—(Oct. 5, '89.) Prest., Moses Hopkins. Secy. and Treas., C. A. Grow, San Francisco. Supt., L. Wellendorff.

NOTE.—Official information cannot be obtained, following having been received from S. B. Touse, dated Oct. 5, '89:—"The board of directors of this Co. instruct me not to give the desired information for the MANUAL regarding our Co. and works." Above given in '88 by W. G. Raymond, Berkeley.

WILMINGTON and SAN PEDRO, *Los Angeles Co.* (Pop.: Wilmington township, 1,865; est., 1,100. San Pedro, est., 1,500.) Latter is incorp. Has sewers and electric lights.

History.—Built in '82 by Wilmington Development Co., under 50-years franchise. Contr. for masonry, Cyrus Willard, Los Angeles.

Water Supply.—Wells, pumping to tanks and direct.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; one Blake and one 750,000 Dow comp., dup.

Tanks.—Cap., 150,000 galls.; 3 of equal cap.

Distribution.—*Mains*, w. i., 8 miles; from Mellert Foundry & Machine Co., Reading, Pa. *Services*, w. i. *Taps*, 600. *Meters*, Worthington and Hersey, 7. *Hydrants*, Eddy, 12. *Valves*, Eddy.

Consumption, 200,000 galls. *Pressure*, 50 to 120 lbs.

Financial.—Cost (in '87), $50,000. All other figures withheld. *Est.*: Ann. op. exp., $2,500. Ann. rev.: total, $10,000.

Management.—Owned by J. B. Banning, Prest. Engr., A. Young.

WHEATLAND, *Yuba Co.* (Pop., 635; est., 1,000.) Incorp. town. No sewers or electric lights.

History.—Built in '89-90 by Wheatland Water Co.; put in operation about Apr. 1. No Engrs. or Contrs.

Water Supply.—Well, pumping direct and to tanks. No filtration.

Pumping Machinery.—Dy. cap., 288,000 galls.; Blake, No. 8.

Tanks.—Cap., 70,000 galls.

Distribution.—*Mains*, 1 mile. *Services*, w. i. *Taps*, 70. *Meters*, none *Hydrants*, 20.

Consumption, 30,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—Cost, $6,000. Cap. stock, authorized, $10,000; paid up, $6,000. No debt. Ann. op. exp., est., $1,200. Ann. rev.: consumers, est., $1,500; city, none. Hydrant rental, free.

Management—Prest., Jno. Sternman. Secy., H. C. Niemeyer. Treas., T. H. Thomas. Report, Feb. 19, '90.

WOODLAND, *Yolo Co.* (Pop., 2,257; est., 4,500.) Incorp. No sewers. Has electric lights.

History.—First supplied in '73 by Co. These works were rebuilt, or second Co. organized in '84. Following is description of Woodland Water Co's works, built in '85, with S. Shryock as Const. Engr.,

Water Supply.—Four 200-ft. artesian wells, pumping direct and to tanks.

Pumping Machinery.—Dy. cap., 1,000,0.0 galls.; one Hooker and one Thompson & Evans.

Tanks.—Cap., 100,000 galls.; four.

Distribution.—*Mains*, w. i., length not given. *Services*, black, i. *Taps*, 850. *Meters*, one. *Hydrants*, Jackson, 24

Consumption, 500,000 galls. *Pressure*, about 25 lbs.

Financial—Cost, $52,000. Cap. stock, $50,000. No debt. Ann. op. exp., $3,000. Ann. rev.: consumers, $12,000; city, $306. Hydrant rental, $12.

Management.—Supt., W. W. Porter.

YREKA, *Siskiyou Co.* (Pop., 1,059.) On Yreka creek. Settled in '51; incorp. village in '55; re-incorp. in '89. Partially sewered. Has electric lights.

History.—Built in '62 by H. Scheld.

Water Supply.—Springs, by gravity. Water is collected in wooden conduit ins. sq., with fall of 1 in 200. Owing to unprecedented drought, pumping system was introduced in '89, pumping to flumes 51 ft. from top of water into underground reservoir.

Pumping Machinery.—Dy. cap., 288,000 galls.; one 15-H. P. Westinghouse engine, and one No. 2½ Heald & Sisco centrifugal pump.

Tank.—Cap., 60,000 galls.; of wood, from 22 to 50 feet above, and ½ mile from town, with which it is connected by bored pine logs, 6 ins. in diam.

Force Main.—Of 4-in. rivetted steel pipe, 2,000 ft. long, connecting reservoir with flume.

Reservoir.—Not described.

Distribution.—*Mains*, c. i., 2½ miles. *Services*, black i. *Taps*, 100. *Meters*, none. *Hydrants*, none, but there are 12 fire cisterns.

Consumption, 90,000 galls. *Pressure*, light.

Financial.—Cost, $30,000. Debt, $3,000. Int., 10%. Ann. op. exp., $1,600. Ann. rev.: consumers, $3,600; city, $50.

Management.—Owner, Henry Scheld.

YUBA CITY, *Sutter Co.* (Pop., est., 600.) On Feather river. Manufactures wagons and agricultural implements.

General Description.—Built in '89 by Yuba City Water-Works Co. Supply pumped to tank. Tank (unofficial) cap., 50,000; on tower, with 20 x 40 ft. base. Cap. stock (unofficial), $25,000. Prest., J. K. P. Elwell. Secy., A. B. Van Arsdale. Report, Oct. 14, '89.

Water-Works Projected with Fair Prospect of Construction.

BLUE LAKE, *Humboldt Co.* (Pop., est., 600.)

Proposed Works.—Blue Lake Water Co. to build. Supply, mountain stream, by gravity. Est. cost, $3,000. Officers: David Powers and C. Chartain. Report by S. Baxter; date, Dec. 15, '89.

FOLSOM, *Sacramento Co.* (Pop., est., 1,000.) On American river.

Proposed Works.—Watoma Water & Mining Co. to lay main from reservoir to and through business street. Est. cost, $1,600; raised by subscription of residents. Supt. of above Co., Chas. Schussler. Report, July 24, '89

LAKEPORT, *Lake Co.* (Pop., est., 1,500.) On Clear lake.

Proposed Works.—Town has voted bonds for works est. to cost $15,000. Supply, Scott's creek, 2¾ miles distant, pumping to reservoir. Report, Feb. 5, '90.

LOS GATOS, *Santa Clara Co.* (Pop., est., 1,800.)

Proposed Works.—Unofficially reported in '89 that works with dy. cap. of 50,000 galls. were to be built by B. P. Rankin and T. Gibson.

SANTA ANA, *Los Angeles Co.* (Pop., 3,024; est., 6,000.)

Proposed Works.—Franchise granted in or about Oct., '89 to James J. Hedges. Apr., '90, unofficially reported that city wished plans and specifications for works costing not over $50,000, and having dy cap. of 1,500,000 galls. Works described in MANUAL for '88, p. 527, as under construction were not built.

Water-Works Projects Reported in '89 and '90, but Now Indefinite.

Vacaville, Solano Co.

ARIZONA.

Water-Works Completed or in Process of Construction.

PHOENIX, *Maricopa Co.* (Pop., 7,000.) On Salt river. Engaged in mining. Incorp. Sewers contemplated. Has electric lights.

History.—Built in '87-'8 by J. J. Gardiner & Son, under 50-years franchise. Const. Engr., F. W. Hutchinson. Works were consolidated in '89 with another system; new name of Phoenix Water-Works Co.

Water Supply.—Wells, pumping to stand-pipe and tank, and direct.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two 1,000,000 Deane comp., cond., two 500,000 Blake. *Boilers:* two, 100-H. P.; tubular.

Stand-Pipe.—Cap., 11,500 galls.; 14 x 100 ft.; steel; from Jno. O'Brien Boiler Works, St. Louis, Mo.

Tank.—Cap., 20,000 galls.; 60 ft. high., on 3 brick columns.

Distribution.—*Mains,* kal. i., 8½ miles. *Taps,* 250. *Meters,* none. *Hydrants,* 50.

Consumption, 800,000 galls. *Pressure:* Ordinary, 80 lbs. Fire, 150 lbs.

Financial.—Cost, $77,000. Cap. stock, of new Co., not given; old, about $10,000. Bonded debt, $50,000. Int., 6%. Sinking fund, $4,000 after 5 years. Ann. op. exp., $4,000. Ann. rev.: consumers, $12,000; city, $3,500. Hydrant rental, $70.

Management.—Prest., J. J. Gardiner. Secy. and Supt., J. M. Gardiner.

PRESCOTT, *Yavapai Co.* (Pop., 1,836; est., 4,500.) In mining, stock raising and agricultural region. No sewers. Has electric lights.

History.—Built in '84 by town. Const. Engr. and Contrs., Inman Bros., N. Y. City.

Water Supply.—Creek, pumping to reservoir.

Pumping Machinery.—Dy. cap., 500,000 galls.: make not given.

Dam and Reservoir.—Cap., 5,000,000 galls.; 150 x 200 ft., x 25 ft. deep.; 185 ft. above town. Dam, founded on bed rock, in creek.

Filter.—Brick.

Distribution.—*Mains,* 8 to 4-in. w. i., 3 miles. *Services,* w. i. *Taps,* 395. *Meters,* 45. *Hydrants,* Ludlow, 37. *Valves,* Ludlow.

Consumption, 60,000 galls. *Pressure:* Ordinary, 100 lbs. Fire, 130 lbs.

Financial.—Cost, $60,000. Bonded debt, $60,000. Int., 8%. Ann. op. exp., $4,800. Ann. rev.: consumers, $5,000; city, est., $700. Hydrant rental, $20.

Management.—City Council. Engr., J. F. Mahoney.

TOMBSTONE, *Cochise Co.* (Pop., 973; est., 6,000.) A mining town. Settled about '78. Incorp. No sewers or electric lights.

History.—Built in '81-2 by Huachuco Water Co., under 50-years franchise. Former supply was introduced by Sycamore Springs Water Co., which is now controlled by this Co. Water is brought from Sycamore springs, 8 miles distant, through w. i. pipe to two small tanks, having cap. of 40,000 galls., 50 ft. above town. Later, Tombstone Water, Mill & Land Co. brought water from stream 2½ miles distant to a 110,000-gall. reservoir on Comstock hill, near town. It is not stated whether the latter of these Cos. is now in existence.

Water Supply.—Collecting reservoir at head of Miller's canyon, 25 miles south of city, by gravity to distributing reservoir.

Collecting Reservoir.—Is 100 x 80 ft., x 22 ft. deep; 1,000 ft. above city.

Conduit.—Of 7-in. lap-welded w. i., 25 miles long. It passes down canyon, across San Pedro valley, 1,900 ft. lower than source, then up to distributing reservoir. Supply carried by conduit is increased by water from spring in lateral canyon, introduced through 3-in. pipe, under 1,800-ft. head, and also from Carr's canyon, through 5-in. pipe, 4 miles long.

Distributing Reservoir.—Cap., 1,200,000 galls.; 80 x 90 ft., x 20 ft. deep, 360 ft. above principal street of city; excavated in rock, lined with stone masonry, having its bottom covered with Portland cem. concrete. Two 7-in. pipes lead to city.

Distribution.—*Mains*, kind not given, 25 miles. *Taps*, not given. *Meters*, 50, for mines. *Hydrants*, 46.

Consumption, 450,000 galls. *Pressure*, 160 lbs.

Financial.—Cost, $500,000. Other data withheld. *Est.:* Ann. op. exp., $5,000. Ann. rev.: total, $20,000.

Management.—Prest., Chas. H. Stone. Secy. and Treas., Hugh Porter. Supt., J. W. Clark. Office, No 11 Pine St., N. Y. City.

TUCSON, *Pima Co.* (Pop., 7,007; est., 8,500.) On Santa Cruz river. Engaged in mining and in reduction of ores.

History.—Built in '81, by Tucson Water Co., under 25-years franchise. Engr., Jno. P. Culver.

Water Supply.—Santa Cruz river, by gravity.

Conduit.—Unofficially reported as 5 miles long, and of 12-in. pipe.

Distribution.—(In '87.) *Mains*, kind not given, 6 miles. *Services*, not given. *Taps*, 500. *Meters*, 13. *Hydrants*, 50

Consumption, 160,000 galls. *Pressure:* Ordinary, 38 lbs. Fire, 52 lbs.

Financial.—(In '87.) Cost, $80,000. Cap. stock and bonds, $150,000. Int., 8%. Ann. op. exp., $4,000. Ann. rev.: consumers, $15,500; city, $2,500. Hydrant rental, $50.

Management.—(In '88.) Supt., R. N. Leatherwood. Other officers: A. Granby, J. B. Watts. Report by D. J. Baleyn, Chf. City Fire Dept.

NOTE.—No report for '89 could be obtained.

NEVADA.

Water-Works Completed or in Process of Construction.

AUSTIN, *Lander Co.* (Pop., 1,679; est., 1,500.) Engaged in mining. Not incorp. Has sewers. No electric lights.

History.—Built in '65 by Austin City Water Co., under a 15-years franchise, which has been renewed for 15 years more.

Water Supply.—Tunnel driven into mountain, by gravity from reservoir.

Reservoir.—Cap., 50,000 galls.; brick, 500 ft. above city.

Distribution.—*Mains*, riveted galv. i., w. i., 2 miles. *Services*, w. i. *Taps*, 250. *Meters*, none. *Hydrants*, from Hinckley & Co., San Francisco. 17 reported in '87; report for '89 says "none."

Consumption, 25,000 galls. *Pressure*, 97 lbs.

Financial.—Cost (in '87), $20,000. No stock, bonds or debt. Ann. op. exp. (in '87), about $2,400. Ann. rev.: consumers, withheld, est., $6,000; city, not given. Hydrants free.

Management.—Prest., W. W. Bisbott. Secy., R. W. Heath. Agt., W. Foster. No Supt.

CANDALARIA, *Esmeralda Co.* (Pop., 756.)

History.—Built in '82 by Candalaria Water-Works & Milling Co., Ltd., of London. Des. Engr., W. J. Sutherland. Const. Engr., Nelson Westcott, present Supt. Labor done by Co.

Water used chiefly for mills, mining works and railways.

Water Supply.—Springs in White Mts., about 30 miles distant, by gravity.

Reservoir.—Cap., 500,000 galls.; 80 x 90 ft., x 11 ft.; mostly in excavation on side of hill. Where embankment was necessary, masonry wall was carried to bottom of reservoir; 4 ft. wide at top, 10 at bottom. Inner slopes, 70 degrees, lined with solid concrete wall, 9 ins. thick, composed of one part cem., two parts sand, four parts gravel. Bottom laid with 6 ins. concrete. *Discharge-pipes:* 6-in. supply and 6-in. waste, carried beneath bottom of wall, and overflow pipe at top of wall. Built in '88. Engr. and Contr., see History. Cost, $6,000.

Distribution.—*Mains*, 5 and 4-in., w. i., 30 miles, most of which is supply conduit. *Services* and *Taps*, not given; 300 to 500 people supplied. *Meters*, none. *Hydrants*, 4.

Consumption, 100,000 galls. *Pressure*, from 300 to 1,000-ft. head.

Financial.—(In '87.) Cost, $250,000. Bonded debt, $250,000. Int., 3%. Ann. op. exp., $10,000. Ann. rev.: consumers, not given, est., $50,000.
Management.—Supt., Nelson Westcott.

CARSON CITY, *Armsby Co.* (Pop., 4,229; est., 4,000.) Is 4 miles from Carson river. Has electric lights.
General Description.—(For '88.) Owned by Co. Gravity system. *Hydrants*, 32. Ann. op. exp., $1,600. Supt., Alfred Helm. A full report has never been received.

ELKO, *Elko Co.* (Pop., 752.) On Humboldt river.
History.—Built in '72-4 by Hi Lay Co. Engr., Robt. Cullen.
Water Supply.—Humboldt river, by gravity.
Reservoir.—Cap., 4,600 galls.
Distribution.—*Mains*, 3,500 ft.
Pressure, 75-ft. head.
Financial.—Cost, $2,740. No debt.
Management.—Supt., Hi Lay. Report by T. N. Stone.
NOTE.—No report for '89 could be obtained.

EUREKA, *Eureka Co.* (Pop., 4,207; est., 2,000.) Engaged in mining, smelting and reducing silver ore. Settled in '64. Not incorp. No sewers or electric lights.
History.—Built in '71 by W. W. McCoy, and now owned by Mrs. May J. McCoy.
Water Supply.—Springs, collected in tanks, by gravity.
Tanks.—Cap., 250,000 galls.; six.
Distribution.—(In '87.) *Mains*, w. i., 20 miles. *Services*, w. i. *Taps*, 900. *Meters*, none. *Hydrants*, 20.
Consumption, 200,000 galls. *Pressure:* Ordinary, 45 lbs. Fire, 100 lbs.
Financial.—Cost, to '82, $60,000. No stock, bonds or debt. No further figures given.
Management.—Supt., Geo. F. Bliss.

GOLD HILL, *Storey Co.* See Virginia City.

HAMILTON, *White Pine Co.* (Pop., 203; est., not given.) Is 8,500 ft. above city. Settled in '67; incorp. city in '69, and disincorp. in '75. This was once an active mining town, but has been nearly abandoned.
History.—Built in '69 by Eberhardt Mining Co. Des. Engr., H. W. Von Schmidt. Water is now used principally for mining purposes.
Water Supply.—Illapoh springs, pumping to reservoir. There are 3 pumping stations; first pumps lifting water 500 ft. in a mile, the second 500 ft. more to reservoir, from which it flows two miles across deep valley and up Treasure Mt. to reservoir level, where it is again repumped, this time through 1½ miles of pipe, up mountain to Treasure City, further height of 700 ft.
Pumping Machinery.—Dy. cap., not given; two Cameron pumps, at each of first two stations, with 22½ x 60-in. steam, and 10-in. water cylinders. Pumps at the third station are not described.
Force Mains.—Of 12-in. riveted w. i., with c. i. hub joints, leaded. Pipe is ¼ in. thick for first 250-ft. rise, and ⅛ in. for last, between each station. It frequently bursts. Normal working pressure at each station is 217 lbs., but by irregular action it sometimes reaches 250 lbs. To relieve pipe compressed air is forced into 4 chambers on line. Third force main is 1½ miles long, size not given.
Reservoir.—Cap., 2,000,000 galls.; of stone, 500 ft. above Hamilton.
Distribution.—(In '81.) *Mains*, 14 miles; No. 11 gauge 3-in. lap welded w. i., with c. i. sleeve couplings and lead joints. This pipe was too light, not well coated with asphalt and rusted through in wet ground. *Services*, w. i. *Taps*, 125. *Meters*, 20. *Hydrants*, 20.
Consumption (in '81), 10,000 galls. *Pressure*, Ordinary, 45 lbs. Fire, 200 lbs.
Financial.—Cost to '81, $380,000.
Management.—Not given. Address, T. Hagar.
NOTE.—The last report from these works was in '81, and the above describes the works as they had been previously.

PIOCHE, *Lincoln Co.* (Pop., 745.) Mining town, about 7,000 ft. above sea. Settled in '69.
History.—Built '72 by individuals; formerly known as Floral Springs Water Co. With decline of town, works from '78 to '83 did not pay salary of Supt., R. H. Elam and other expenses, and in '83 works came into hands of Mr. Elam. In '88 Mr. Elam

died, and works were sold by heirs to W. Godbe & Co., but Administrator, Jas. McFadden, not having been consulted refused to deliver works; matter had not been settled at last reports. Works were designed by Geo. Coffee.

Water Supply.—Two springs, by gravity to tanks. Springs have dy. yield of about 50,000 galls. are about 5¼ miles from and 500 ft. above town, pipe line passing over very irregular ground, descending nearly 300 ft. below town.

Tanks.—Cap., 200,000 galls.; two, of wood, one 300, and other about 200 ft. above town.

Distribution.—(In '87.) *Mains*, 8 to 5-in. i., 7 miles. *Services*, w. i. *Taps*, not given. *Meters*, none. *Hydrants*, Garrett, about 12.

Consumption, not given. *Pressure*, 300 ft. head.

Financial.—(In '87.) Cost, about $150,000. Ann. op. exp., $2,000. Ann. rev.: consumers, about $3,500; city, $2,000. Hydrant rental, not given.

Management.—Address, Jas. McFadden. Report by Frank Godbe.

NOTE.—No report for '89 could be obtained.

RENO, *Washoe Co.* (Pop., 1,302; est., 3,000.) On Truckee river, which furnishes water-power. Settled in '69; incorp. town in 79. Has sewers and electric lights.

History.—Built in '73 by A. A. Evans.

Water Supply.—Truckee river, by gravity through ditch 14 miles long to reservoir.

Reservoir.—In embankment, 180 ft. above town.

Distribution.—*Mains*, 15 to 2-in. riveted w. i., 12 miles. *Services*, iron. *Taps*, 700. *Meters*, none. *Hydrants*, 10.

Consumption, 1,280,000 galls. *Pressure*, 90 lbs.

Financial.—Not given, except that there is no debt.

Management.—Prest., C. C. Powning. Secy., N. W. Robb.

SILVER CITY, *Lyon Co.* See Virginia City.

TUSCARORA, *Elko Co.* (Pop., est., 2,500.) Engaged in silver mining.

General Description.—In '88 the Tuscarora Water Co. were building works, taking supply from Twin Bridges creek. Cost, est., $150,000. Prest., P. C. Hyman. Supt., H. W. Coffin. Engr., Hermann Schussler, San Francisco.

NOTE.—No further information can be obtained. Report for '89 merely states that the above is correct.

VIRGINIA CITY, GOLD HILL and SILVER CITY, *Storey Co.* (Pop.: Virginia City, 10,917; est., 8,000. Gold Hill, 4,531. Silver City, 605.) These towns are on east side of Mt. Davidson, and have mining industries. Virginia City is 6,200 ft. above sea. Gold Hill is on Gold run, a dry ravine one mile from Virginia City, and 200 ft. lower, and Silver City is one mile further down ravine. Virginia City was settled in '59. Have sewers and electric lights.

History.—Built in '72 by Co. Des. Engr., Hermann Schussler, San Francisco. Later work has been in charge of the Supt., J. B. Overton. All labor done by Co. Before '72 water had been obtained from tunnels driven into mountains.

Water Supply.—Creeks and artificial lake, by gravity from impounding to distributing reservoirs. Hobart creek has drainage area of 12 sq. miles; Folsom creek, 10 sq. miles; other creek, 7 sq. miles; Marlette lake, an artificial lake formed by dam, of 5 sq. miles.

Dam and Marlette Lake.—Area, 800 acres. Dam, of stone masonry in cem., 170 ft. long, 30 ft. high.

Conduit.—From impounding to distributing reservoirs. For 22 miles it is a plank flume, 16½ x 18 ins., with grade of 20 ft. per mile. Across Washoe valley, between Sierra Nevada and Mt. Davidson ranges, 7 miles, water is conveyed in 3 w. i. pipes, one 12-in. riveted, one 10-in. and one 11-in. lapwelded; at lowest point these pipes are 1,496 ft. below outlet.

Distributing Reservoirs.—Cap., 12,100,000 galls.; two, having cap. of 8,300,000 and 3,800,000 galls, respectively. First is in rock excavation, 270 x 300 ft.. x 15 ft. deep at 350 ft. above Virginia City. Second is in rock excavation, 170 x 180 ft., x 8 ft. deep, at 150 ft. Gold Hill.

Distribution.—*Mains*, w. i., 29 miles. *Services*, w. i. *Taps*, (in '88) 2,300; 1,525 in Virginia City, 600 in Gold Hill, and 175 in Silver City. Only about ⅔ of these are now in use. *Meters*, not given; put on where waste is suspected, and removed when the question is settled. *Hydrants*, 158.

Consumption, 8,600,000 galls. *Pressure:* Ordinary, 90 lbs. Fire, 130 lbs.

Financial.—Cost (in '87), about $2,800,000. No debt. Ann. op. exp., $54,000. Ann rev.: consumers, $192,000; cities, $5,280. Hydrant rental: $39.24 in Virginia City, $57.69 in Gold City, $15 in Silver City.

Management.—Prest., W. S. Hobart. Secy., W. W. Stetson, San Francisco, Cal. Supt., J. B. Overton.

WINNEMUCCA, *Humboldt Co.* (Pop., 763; est., 1,400.) On Humboldt river in mining district. Settled about '70. Not incorp. No sewers or electric lights.

History.—Built in '77 by Co. Des. Engr., J. Culver.

Water Supply.—Cross canyon, by gravity and pumping.

Pumping Machinery.—Dy. cap., 500,000 galls.; Dow.

Storage Reservoir.—Cap., about 1,000,000 galls.; in canyon; 100 ft. sq. x 16 ft. deep, at 950 ft. above town.

Conduit.—Of 7-in. w. i. pipe, to distributing reservoir.

Distributing Reservoir.—Cap. not given; 125 ft. above town.

Distribution.—*Mains*, w. i., 10 miles. *Services*, w. i. *Taps*, 150. *Meters*, none. *Hydrants*, 18.

Consumption, 700,000 galls. *Pressure*, 60 lbs.

Financial.—Cost, $20,000. No debt. Ann. op. exp., $5,000. Ann. rev.; consumers, withheld, est., $3,000; city, none.

Management.—Prest., Secy., and Treas., Francis Smith. Supt., Joe Rongon.

UTAH.

Water-Works Completed or in Process of Construction.

LOGAN, *Cache Co.* (Pop., 3,396; est., 6,000.) On Logan river, on three plateaux rising from river. Has water-power. Settled in '59; incorp. city in '66. Has electric lights.

History.—Built in '79 80 by city. Des. Engr., Jas. H. Martineau. Const. Engr., David J. James, Salt Lake City.

Water Supply.—Logan river, by gravity, from point 2½ miles above town, through two settling basins to reservoir.

Conduits.—A canal, 20 ft. wide at bottom, and 1¾ miles long, leads to first settling basin, which is connected with second by flume 12 x 16 ins., and 1,100 ft. long, of 2-in. pine plank laid 5 ft. below surface for part of distance, and by conduit of stone in cem. for remainder. Second basin and reservoir are connected by 1,300 ft. of pipe.

Settling Basins and Reservoir.—Former are not described in report. Reservoir is 20 x 65 ft., x 12 ft. deep, in excavation, with 2-ft. stone walls in cem., and with concrete bottom; in 6 compartments, water passing through 3 on either side of central wall, with screens between each, so that either side can be cleaned while the other is in use. Reservoir is 103 ft. above main part of city, and 130 ft. above lower part.

Distribution.—(In 87.) *Mains*, c. i., wood, 3 miles. *Services*, galv. i. *Taps*, 20. *Meters*, none. *Hydrants*, Ludlow, 14. *Valves*, Ludlow.

Consumption, 240,000 galls. *Pressure*, 50 lbs.

Financial.—(In '87.) Cost, $11,000. No debt. Ann. op. exp., $700. Ann. rev.: consumers, $700.

Management.—Supt., Jas. Adams.

NOTE.—No report for '89 could be obtained.

NEPHI, *Juab Co.* (Pop., 1,797; est., 3,000.)

History.—Built in '89-90 by city. Engrs., Sturges & Bryant, Salt Lake City. Supt. of Construction, Peter Sutton, Nephi.

Water Supply.—Springs, by gravity to and from distributing reservoir. Springs in canyon, 4 miles from, 160 ft. above, city.

Reservoir.—Cap., 30,000 galls.; redwood.

Distribution.—*Mains*, 10 to 3-in. spiral-rivetted, asphalted w. i., about 5¼ miles. *Hydrants*, 12.

Financial.—Cost, $12,000.

Management.—Address Alma Hague or J. Hickman. Latest report, Jan. 17, '90.

OGDEN, *Weber Co.* (Pop., 6,069; est., 10,000.) At junction of Ogden and Weber rivers, 4,200 ft. above the sea. Has manufactories. Settled in '50; incorp. in '51. Has electric lights.

History.—Owned by city; built in '80-2 by Co. Contrs., Jos. A. West and David Jenkins. In '89 city contracted with Bear Lake and River Water-Works & Irrigation Co. for an increased supply and general extension of the distributing system. By this contract Co. will have control of works and rentals therefrom. City will have perpetual right to buy distributing system at cost, and pay for same in 6% bonds; in case city buys distributing system it must pay $150,000, in three yearly instalments, without int., for perpetual use of supply conduit, city also to pay its share of repairs on conduit.

Water Supply.—Ogden river, by gravity. River rises in Wahsatch Mts.

Dam and Reservoir.—Cap., 275,000 galls. Water surface 250 ft. above lowest, and 100 ft. above highest part of the city. Dam is 5 ft. high, on river.

Supply Conduit.—Of 8-in. Horton wood, about 3 miles long.

Distribution.—(In '84.) *Mains*, Horton wood, 13 miles. *Services*, galv. i. *Taps*, 310. *Meters*, 1. *Hydrants*, 39.

Consumption (in '87), 345,600 galls. *Pressure:* Ordinary, 60 lbs. Fire, 80 lbs.

Financial.—(In '87.) Cost, $100,000. Debt, not given; none in '84. Ann. op. exp. $1,500. Ann. rev.: total, $12,000.

Management.—Com. Supt., Job Pingree.

PARK CITY, *Summit Co.* (Pop., 1,542.) On Silver creek, ground rising steeply each way from stream. A mining town. Settled in '70. Incorp. Has sewers and electric lights.

History.—Built in '80 by private Co. Des. Engr., W. M. Ferry.

Water Supply.—Mountain stream, one mile from town, by gravity.

Dams and Reservoirs.—Cap., 1,000,000 galls.; 3, lowest of which is 200 ft. above city. Dams, 3 of dry stone, on brush and filled in on each side with coarse gravel, built across creek. Water falls 12 ft. over first dam to second reservoir, and also over second reservoir to third. A tight box flume passes under two lower dams so that two upper reservoirs can be cleaned or emptied without disturbing lower.

Distribution.—*Mains*, Horton wood, 3 miles. *Services*, galv. i. *Taps*, 250. *Meters*, none. *Hydrants*, 14.

Consumption, unknown. *Pressure*, 86 lbs.

Financial.—Cost, $19,000. No debt. Ann. op. exp., $360. Ann. rev.: consumers, $3,000; city, $519. Hydrant rental $39.

Management.—Prest., E. Kimball. Secy., C. E. Allen. Treas., Thos. Cupit. Supt., Walter Willcocks.

SALT LAKE CITY, *Salt Lake Co.* (Pop., 20,768; est., 30,000.) On Jordan river, 4,320 ft. above sea. Part of the city is on nearly level plain and remainder on mountain bench. Streets are each 132 ft. wide. Settled in '47; incorp. a city in '51. Sewers under construction. Has electric lights.

History.—Built by city in '74. Des. Engr., Thos. W. Ellerbeck.

Water Supply.—City creek, by gravity. Creek has drainage area of 30 sq. miles, a dy. flow 10,000,000 galls., and is fed by springs and melting snow. In summer much water is used for irrigation, it being carried along the gutter each side of the street. In '89 it was unofficially reported that several artesian wells had been sunk, giving additional dy. supply of 4,000,000 galls.

Dam.—Of timber, across creek, to divert water into conduit.

Supply Conduit.—Of redwood, 2½ x 4½ ft., leading to tanks or reservoirs.

Reservoirs.—Cap., 400,000 galls.; six, first two are 16 x 29 ft., and 15½ x 28 ft., each 10 ft. deep at about 180 ft. above northern, and 225 ft. above southern and western parts of city.

In addition new reservoir was under construction in '89; cap., 7,000,000 galls. Another, on Capitol Hill, with 6,000,000 galls. cap. was projected; unofficially reported that contracts have been let.

Distribution.—*Mains*, 30 to 3-in. c. i., 28⅛ miles; from Dennis Long & Co., Louisville, Ky., for extension of 10 miles made in '88. *Services*, lead. *Taps*, 2,813. *Meters*, none. *Hydrants*, made by Davis Howe & Co., Salt Lake City, 179. *Gates*, Coffin.

Consumption, 4,000,000 galls., including water used for irrigating purposes. *Pressure*, 86 lbs.

Financial.—Cost, $400,000. Debt, not given. Ann. op. exp., $9,000. Ann. rev.: consumers, $30,000; city (In '87), $11,456.

Management.—Supt., G. M. Ottinger.

Water-Works Projected with Fair Prospects of Construction.

BRIGHAM CITY, (*Box Elder P.O.*) *Box Elder Co.* (Pop., not given.)
Proposed Works.—There has been talk of supply from Bear Lake & River Water Works & Irrigating Co.

CORINNE, *Box Elder Co.* (Pop., 277; est., not given.)
Proposed Works.—Probably will be supplied by Bear Lake & River Water Works & Irrigation Co., but not at once.

PROVO CITY, *Utah Co.* (Pop., 3,432; est., 6,500.) On Provo river. Has grist and sawmills, tanneries and woolen factory.
Proposed Works.—Plans for works to be owned by city made by Sturges & Bryant, Salt Lake City. Council had not decided to build, but it was thought that it would do so. Three miles canal, 2,000,000-gall. settling, 1,000,000-gall. distributing reservoir, about 9 miles 12 to 4-in. pipe, 36 hydrants; est. cost, $64,511. Report, Feb. 12, '90.

IDAHO.

Water-Works Completed or in Process of Construction.

BELLEVUE, *Logan Co.* (Pop., est., 2,000.) Incorp. town. No sewers or electric lights.
History.—Built in '87 by Bellevue Water Co., under perpetual franchise; charter is for 49 years. Const. Engr. and Contr., John Corkish, Portland, Oregon. Des. Eng., H. E. Miller, Bellevue.
Water Supply.—Seamaus creek, by gravity from impounding reservoir.
Dam and Impounding Reservoir.—No data.
Distribution.—*Mains*, 12 and 3-in., wood, 5½ miles; from Puget Sound Pipe Co., Olympia, Wash. *Services*, galv. i. *Taps*, 200. *Meters*, none. *Hydrants*, Portland, 8. *Valves*, Kennedy.
Consumption, 161,175 galls. *Pressure*, 65 lbs.
Financial.—Cost, $15,000. Cap. stock, $30 000. No debt. Ann. op. exp., $750. Ann. rev.: consumers, $3,756; city, $328. Hydrant rental, $41.
Management.—Prest., H. E. Miller. Secy. and Supt., H. F. Baker.

EAGLE ROCK. *Bingham Co.* (Pop., est., 250.)
History.—Built in '85 by Eagle Rock Water-Works Co. Engr., C. H. Clark. Labor done by Co.
Water Supply.—Snake river, pumping to tanks.
Pumping Machinery.—Cap., 144,000 galls.; No. 8 Knowles, driven by Halladay windmill. *Boiler:* Shapley, for reserve.
Tanks.—Cap., 70,000 galls.; two.
Distribution.—(In '87.) *Mains*, c. i., w. i., 1½ miles. *Services*, w. i. *Taps*, 20, *Meters*, 1. *Hydrants*, 4.
Consumption, 35,000 galls. *Pressure:* Ordinary, 20 lbs. Fire, 100 lbs.
Financial.—(In '87.) Cost, $8,000. Cap. stock, $8,000. Debt., $2,000. Int., 12%. Ann. op. exp., $1,700. Ann. rev.: consumers, $1,700. Hydrants free.
Management.—Prest. J. M. Bennett, Pocatello. Secy., W. H. B. Crow.
NOTE.—No report for '89 could be obtained.

HAILEY, *Alturas Co.* (Pop., est., 2,000.) On Wood river in mining country. Not incorp. No sewers. Has electric lights.
History.—Built in '84 by Alturas Water Co.
Water Supply.—Indian creek, by gravity. Storage tanks and 40-ft. increase in head projected in '89.
Reservoir.—Cap., 250,000 galls.; in embankment, 110 ft. above town.
Distribution.—*Mains*, kal. i., 3 miles. *Services*, w. i. *Taps*, 150. *Meters*, none. *Hydrants*, Ludlow, 5.
Consumption, not given. *Pressure*, 36 lbs.
Financial.—Cost, $20,000. Cap. stock and bonded debt, not given. Ann. op. exp., $1,800. Ann. rev.: consumers, $1,000. Hydrants free.
Management.—Prest., Texas Angel. Secy., Alex. Willman. Supt. W. L. Rily

KETCHUM, *Alturas Co.* (Pop., est., 500.) In Wood river mining district. Not incorp. No sewers or electric lights.

History.—Built in '89 by Ketchum Spring Water Co.; put in operation about Aug. 1, '89. Des. Engr., I. I. Lewis, Ketchum. Const. Engr. and Contr., Jno. Corkish, Portland, Ore.

Water Supply.—Springs, by gravity to and from reservoir.

Reservoir.—Cap., 100,000 galls.; 22 x 67 ft., x 9 ft. deep.

Distribution.—*Mains*, 8 to 4-in. wood, about 3 miles; from Puget Sound Pipe Co., Olympia, Wash. *Taps*, 100. *Meters*, none. *Hydrants*, Portland, 7. *Valves*, Kennedy.

Consumption, 12,000 galls. *Pressure*, 50 to 60 lbs.

Financial.—Cost, $12,000. Cap. stock, authorized, $24,000; paid up, $7,000. Debt, $5,000. Int., 9%. No bonds. Ann. op. exp., est., $150.

Management.—Prest., Geo. Steward. Secy. and Supt., Geo. M. Snow. Treas., Wm. H. Greenhow. Latest report, Mar. 24, '90.

POCATELLO, *Bingham Co.* (Pop., est., 2,000.) Has electric lights.

History.—Built in '82 by Union Pacific Ry. Co.

Water Supply.—Mountain springs, by gravity, Portneuf river, by pumping to tank.

Pumping Machinery.—Dy. cap., 350,000 galls.; make not given; added in '87.

Tank.—Cap., 100,000 galls.; two having equal cap.; 15 x 24; of wood.

Distribution.—*Mains*, w. i., 2 miles. *Services*, w. i. *Taps*, 50. *Meters*, none. *Hydrants*, 15.

Consumption, 300,000 galls. *Pressure*, not given.

Financial.—Cost, $12,000. Ann. op. exp., $2,000. Ann. rev.: consumers, $400.

Management.—Supt., J. M. Bennett.

Water-Works Projected with Fair Prospects of Construction.

BOISE CITY, *Ada Co.* (Pop., 1,899; est., 4,500.) On Boise river.

Proposed Works.—Eastman Bros have irrigating ditches throughout city Supplied by mountain springs and have proposed to put in hydrants. Another proposition has been made.

MOSCOW, *Latah Co.* (Pop., est., 1,500.) In mining district.

Proposed Works.—City let contract Oct. 1, '89, to G. H. Sutherland, Walla Walla, Wash. Supply, driven wells, pumping direct. Est. cost, $25,000; bonds voted. Report by Lincoln Smith: date, Oct. 15, '89.

---

* GROUP 9.—CANADA: MARITIME PROVINCES.—Water-Works completed, in process of construction or projected, in New Brunswick, Nova Scotia, Prince Edward Island and Newfoundland.

NEW BRUNSWICK.

Water-Works Completed or in Process of Construction.

CARLETON, *St. John Co.* (Pop., 4,800; est., 5,000.) On River St. John, on uneven ground in rocky district. Settled in 1783; incorp. city in 1785. United with Portland and St. John in '89. Has sewers and electric lights.

History.—Built in '60 by city. Des. Engrs., Hurd Peters and J. Edward Boyd.

Water Supply.—Spruce, Ludgate and Menzie lakes, by gravity to reservoir. Lakes have combined area of 4 sq. m., and are 6 miles from and 170 ft. above sea level.

Dam.—Of earth, at outlet of lakes.

Filter.—Of gravel at dam.

Supply Conduit.—Of 12-in. cem.-lined w. i., 6 miles long.

---

* The large number of taps per mile of main, reported in this group, is probably owing to a different usage of the word tap in Canada, meaning number of faucets instead of number of times the street main is tapped.

Reservoir.—Cap., 2,000,000 galls.; in excavation and embankment, 160x180 ft., x 20 ft. deep.

Distribution.—*Mains*, w. i. and cem., 6 miles. *Services*, w. i. *Taps*, 341. *Meters*, none. *Hydrants*, "home made," 35.

Consumption, 300,000 galls. *Pressure:* Ordinary, 90 lbs. Fire, 65 lbs.

Financial.—Cost, $131,000. Bonded debt, $131,000. Ann. op. exp., $2,000. Ann. rev. (in '87): consumers, $5,500; city, none.

Management.—Director of Public Works of city of St. John, A. Chipman Smith.

FREDERICTON, *York Co.* (Pop., 6,218; est., 7,000.) On River St. John. Settled about 1780. Incorp. No sewers. Has electric lights.

History.—Built in '82-3 by city. Engrs., Crafts & Forbes, Boston, Mass. Labor done by local Contrs.

Water Supply.—River St. John, pumping direct.

Intake.—Water passes from crib-well situated on edge of channel of river for a distance of about 600 ft. through a 16-in. w. i. conduit to pump-well. Crib-well is filled with broken stone, except space of 5 ft. sq. in center.

Pump-Well.—Is 15 ft. in diam., 31 ft. deep; on river bank; built of stone, brick, and cem. By arrangement of gates in pump-well, water can be pumped from this or from crib-well.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Gaskill horizontal.

Distribution.—*Mains*, 12 to 2-in. c. i., 9.8 miles; laid by J. J. Newman, Providence, R. I. *Services*, cnam., rustless. and galv. i. *Taps*, 651. *Meters*, none. *Hydrants*, Coffin, 81. *Valves*, Coffin, Whittier.

Consumption, 491,542 Imp., or about 570,000 U. S. galls. *Pressure:* Ordinary, 40 lbs. Fire, 70 lbs.

Financial.—Cost, $111,000. Bonded debt, $100,000. Int., 5%. Ann. op. exp., $5,881. Ann. rev.: consumers, $5,518; city, $4,352 of taxes and $1,600 of hydrant rental, or about $20 each.

Management.—Chn., G. H. Parker. Secy., Chas. W. Beckwith. Supt., Alex. Burchill.

MONCTON, *Westmoreland Co.* (Pop,, 5,032; est., 9,000.) On Petitcodiac river. Has sugar refinery and cotton factory. Settled in 1770; incorp. town in '55, city in '75. Has sewers and electric lights.

History.—Built in '78 by Moncton Gas Light and Water Co. Des. Engrs., Gilbert Murdoch, St. John, and E. H. Keating, Halifax, N. S. Const. Engrs., W. J. Croasdale and Jno. Edington. Most of labor done by day.

Water Supply.—Northwest branch of Hall's creek, by gravity, with pumping as auxiliary, from impounding reservoir. Drainage area, about 23 sq. m.

Dams and Reservoirs.—Cap., 110,000,000 galls. *Low Service:* cap., 70,000,000 galls.; area, 40 acres; depth of water, 27 ft. Dam of clayey soil, on rock, with heart-wall; 250 ft. long, 31 ft. high, water 4 ft. below top; 9 ft. wide at top, 164 at bottom. Inner slope, 3 to 1, 9-in. stone paving, hand laid; outer, 2 to 1, unpaved. *Heart-wall:* selected puddle, 9 ft. thick at bottom, 31 ft. high. *Spillway:* in rock, lined with plank, 100 from end of dam; 2 ft. deep for 30 ft., 4 for 20 ft. in length; free to depth of 2 ft., or over entire length, and provided with gate for lower 2 ft. of 20-ft. length; gate raised by windlass, which can be operated by one man even in time of heavy flood. Slope, about 35 ft. throughout total length of 300 ft., over rock. *Discharge-pipes:* two, 20-in. "No leaks." Built in '78. Des. Engr., Gilbert Murdoch, St. John. Cost, $3,000, exclusive of gate-house and appurtenances.

High Service: cap., 40,000,000 galls.; area, 32 acres; depth of water, 23 ft. Dam of clayey soil, on hard clay and gravel, with heart-wall; 1,500 ft. long, 27 ft. high, water 4 ft. below top; 9 ft. wide on top, 157 at bottom. Inner slope, 3 to 1, 9-in. stone paving, hand laid, on bed of broken stone; outer slope, 2½ to 1. *Heart-wall:* selected puddle, 8 ft. thick at bottom, 4 at top, 26 ft. high. *Spillway:* in embankment, where bank is about 8 ft. high; lined with masonry; 50 ft. wide, 500 ft. long, 4 ft. deep; slope, 6 ins. to 100 ft. *Discharge-pipe:* 15-in. *Culvert:* 2 x 3 ft. Under construction March 12, '90. Engr., Jno. Edington, Moncton. Labor done by the day.

Pumping Machinery.—Dy. cap., not given; Blake.

Supply Conduit.—Of 20 to 12-in. c. i., leading to town; length not given.

Distribution.—*Mains*, c. i., 12 miles. *Services*, lead. *Taps*, 650. *Meters*, none. *Hydrants*, Mathews, 40. *Valves*, Eddy.

Consumption, 750,000 galls., including water supply for several factories. *Pressure*, 42 lbs.

Financial.—Cost (June 1, '89), $101,633; total cost, including gas and electric lights, $132,943 Bonded debt, including gas and electric light plants, $60,000. Int., 6%. Cap. stock, $100,000, on both gas and water plant. Ann. op. exp., withheld, est., $2,500. Ann. rev.: net, $13,866; total net, including gas and electric lights, $25,533. Hydrant rental, $50.

Management.—Prest. and Mgr., Jno. L. Harris. Secy., R. A. Borden. Treas. C. P. Harris.

MILLTOWN, *Charlotte Co.* See St. Stephens.

PORTLAND, *St. John Co.* See St. John.

SAINT JOHN and PORTLAND, *St. John Co.* (Pop.: St. John, 28,895; est., 45,000. Portland, 12, 520; est., not given.) St. John is on Bay of Fundy at mouth of River St. John, on rocky peninsula with steep slopes. Settled in 1780; incorp. city in 1785. Portland adjoins St. John and was settled later. St. John, Portland and Carleton were united in '89. Have electric lights.

History.—Built in '36 by private Co., and abandoned with completion of new works built in '49-50. In '55 city bought works. Engr. for works built in '49-50, Geo. H. Bailoy; for late improvements, Gilbert Murdoch.

Water Supply.—Little river and Lake Latimer, by gravity from impounding reservoir on former. Dam at outlet of lake makes its waters available. This was built in '51. Lake has area of 200 acres, and is 300 ft. above city datum. Conduit brings water from lake to river.

Supply from '36 to '50 was from Lily lake, a natural pond 80 ft. above base of city levels, and about two miles from city. Water was raised 63 ft. to a 300,000-gall. masonry reservoir, steam pump being operated 3 or 4 times a week. Water was admitted to distributing pipes only from 6 to 8 A. M.

Dam and Reservoir.—Area, 37½ acres; 160 ft. above city datum. Dam, on Little river, not described.

Lake Latimer Dam and Conduit.—Not described.

Supply Conduits.—Length of each, 23,000 ft.: c. i. First was 12-in. c. i. In '57, and again '73, a 24-in. pipe was added, and in '81 325 ft. of duplicate was laid.

Distribution.—*Mains*, including supply, 48.4 miles. *Services*, lead, about 24 miles. *Taps* (services), 4,211. [14,870 taps according to Canadian usage.] *Meters*, Crown, Worthington, 111. *Hydrants*, department design, 292. *Valves*, kind, do.

Consumption, 4,783,500 galls. *Pressure*, 40 lbs.

Financial.—Cost, $1,017,301. Bonded debt, $1,007,472: $937,472 at 6, $20,000 at 4½. Authorised bonds still unissued, $21,500. Ann. op. exp., $14,741. Sinking fund, $19,946. Ann. rev., total, $62,502. arrears, $24,768.

Management.—Director of Public Works, A. Chipman Smith. Supt., Gilbert Murdoch.

Reference.—"Special report * * * * on the Formation of Anchor Ice." By Supt. Gilbert Murdoch. Pamphlet, 30 pp. 1881. A valuable report, with illustrations.

SAINT STEPHENS and MILLTOWN, *Charlotte Co.* (Pop., est., 6,000. On St. Croix River, opposite Calais, Me. Engaged in manufacturing. Incorp. No sewers. Have electric lights.

History.—Built in '86-7 by St. Croix Water Co., under 20-years franchise.

An extension of Calais (Me.) Water Co.'s system, which see for description of pumps and reservoir.

Distribution.—*Mains*, c. i., 14 miles; from Warren Foundry & Machine Co., Phillipsburgh, N. J. *Services*, tarred, w. i. *Taps*, 300. *Meters*, 5. *Hydrants*, 75.

Consumption, 150,000 galls. *Pressure*, not given.

Financial.—Cost, not given. Cap. stock (in '88), $200,000. Bonded debt (in '88), $100,000. Int., 5%. Ann. rev.: city, $3,000. Hydrant rental, $50.

Manag-ment.—Prest., Weston Lewis. Secy., Josiah Maxcy. Both of Gardiner, Me. Supt., W. E. McAllister.

WOODSTOCK, *Carleton Co.* (Pop., 3,000, est., 3,200.) On hilly ground on River St. John. Engaged in manufacturing. Settled in '20; incorp. town in '55 Has electric lights.

History.—Built in '81 by town. Engrs., Crafts & Forbes, Boston, Mass.

Water Supply.—River St. John, by direct pumping.

Filter.—Water passes through 5 ft. of loose stone to pump-well.

Pumping Machinery.—Dy. cap., 1,700,000 galls.; pump has 11-in. bucket and 8-in. plunger of 14-in. stroke, and is driven by engine made by Burrell Johnson Iron Co. *Boilers:* two, each 10 ft. long; one is 3½ and other 4½ f . in diam.

Distribution. (In '87.) *Mains*, c. i., 5¾ miles. *Services*, enam. i. *Taps*, 450. *Meters*. 19. *Hydrants*, 79.

Consumption, 93,000 galls. *Pressure:* Ordinary, 63 lbs. Fire, 92 lbs..

Financial.—(In '87.) Cost, $65,000. Debt, $65,000. Int., 4½%. Ann. op. exp.. $2,800. Ann. rev.: consumers, $4.000; city, none.

Management.—(In '88.) Supt., D. Munro.

NOTE.—No report for '89 could be obtained.

Water-Works Projected with Fair Prospects of Construction.

SAINT ANDREWS, *Charlotte Co.* (Pop., 1.800,).

Proposed Works.—Chamcook Water Co. have charter and intend eventually to supply town. Small pumping plant and about 2,500 ft. pipe now supply Algonquin hotel with fresh and salt water. Prest., S. L. Tilley. Treas., Eugene F. Fay, 117 Franklin St.. Boston, Mass. Report, Sept. 28, '89.

NOVA SCOTIA.

Water-Works Completed or in Process of Construction.

AMHERST, *Cumberland Co.* (Pop., 2,000; est., 3,500.) Engaged in mining, manufacturing and ship-building.

History.—Built in '87 8 by Amherst Water-Works Co., Ltd. Engr., James King.

Water Supply.—Springs, by gravity to reservoir.

Reservoir.—Cap., 10,000 ga'ls.

Distribution.—*Mains*, 3-in. spruce, 4 miles. *Services*, galv. i. *Taps*, 50 to 60. *Meters* and *Hydrants*, none.

Consumption, 6,000 galls. *Pressure:* Ordinary, 20 lbs. Fire, 42 lbs.

Financial.—Cost, $6,000. Cap. stock, $20,000. No debt. Ann. op. exp., $300. Rev., not given.

Management.—Prest., G. B. Smith.

ANNAPOLIS, *Annapolis Co.* (Pop., 800; est., 1,000.) On Annapolis river. Engaged in ship-building. Not incorp. No sewers or electric lights.

History.—Built in '89 by town; put in operation Nov. 1. Des. Engr., A. W. Forbes, Boston, Mass. Contr., Wm. Sutherland, Mt. Denison, N. S.

Water Supply.—Lake, by gravity. Area of lake, 24 acres; av. depth, 25 to 30 ft.; 350 ft. above level o town.

Distribution.—*Mains*, 8 to 4-in., 5¼ miles. *Services*, ½-in. enam. i. *Taps*, 75. *Hydrants*, Ludlow, 23. *Valves*, Ludlow.

Pressure, about 160 lbs.

Financial.—Cost, $26,000. Bonded debt, $25,000. Int., 5%.

Management.—Secy., R. J. Uniacke. Report, Jan. 20, '90.

BRIDGETOWN, *Annapolis Co.* (Pop., 800; est., 2,000.) On Annapolis river, at head of navigation. Not incorp. No sewers or electric lights.

History.—Built in '85 by town, Engr., A. W. Forbes, Boston, Mass. Contrs., Sutherland & Cochran, Kentville.

Water Supply.—Three springs, by gravity from reservoir. Water from one spring had been sufficient to '90.

Dam and Reservoir.—Cap., 750,000 galls.; elevation, 276.1 ft.; dam, across gulch formed by spring; gravel on soft clay, with heart-wall; 148 ft. long on top; 50 ft. at foundation, 15 ft. high; carried about 5 ft. below natural surface, stepped into natural bank at each end; 11½ ft. wide at top; inner slope, 2 to 1, outer, ½ to 1, both unpaved. *Heart-wall:* stone masonry in com. *Spillway:* 50 ft. wide; carried around dam, in earth, lined with plank, free. *Discharge-pipe:* 8-in.; extends through dam from small chamber 4½ ft. sq., provided with screens at inlets. Date built, Engrs. and Contrs., see History. Cost, about $1,700.

Distribution.—*Mains*, 8 to 2-in. c. i., 5 miles; from Black & Co., Glasgow, Scotland, and Bridgetown Foundry; coated with Dr. Angus Smith's preparation. *Services*, galv. i. *Taps*, 120. *Meters*, none. *Hydrants*, from Windsor Foundry, 25.

Consumption, 15,000 galls. *Pressure*, 100 lbs.

Financial.—Cost, $22,000. Debt, $20,000. Int., 5%. Sinking fund, $250. Ann. op. exp., $200. Ann. rev.: consumers, $750; city, by assessment, $750. First cost, $17,849.

Management.—Three Comrs. Supt., John L. Cox.

HALIFAX, *Halifax Co.* (Pop., 36,000; est., 45,000, including army and navy.) On peninsula, on hillside rising steeply from harbor, western part being on undulating ground 100 to 250 ft. above sea. Settled in 1749. Incorp. Has sewers and electric lights.

History.—Now owned by city. Built in '45-8 by private Co., when pop. was about 20,000. Des. Engr., John B. Jervis; Const. Engr., Chas. R. Fairbanks. In '61, city bought works for about $275,000. In '68, high service supply was introduced, in accordance with advice of Thos. C. Keefer. Since '72 extensions have been made under direction of the Engr. and Supt., E. H. Keating.

Water Supply.—Long, Upper and Lower Chain lakes for low, and Spruce Hill lakes for high service, by gravity. Dam across south end of Long lake impounds drainage of 6 sq. m., increases lake surface to 380 acres, and gives storage cap. of 800,000,000 galls. From this water passes through Upper to Lower Chain lake, which is 200 ft. above sea, and 3¼ miles from city.

Spruce Hill lakes have area of 170 acres, are 360 ft. above sea, and 9 miles from city.

For description of contamination of Spruce Hill lakes in '74 by vegetable matter, see MANUAL for '88, p. 541.

Nicholson's Dam, Long Lake.—Built in '47, raised 5 ft., repaired, trimmed to shape and strengthened in '78. *Original Dam or Design:* fine gravel and loam, with stone fillings on each slope, and heart-wall; 29 ft. high, 20 ft. wide on top. Inner slope, 3 to 1; toe of bank to vertical height of about 17 ft., small stone and gravel. Outer slope 1½ to 1, formed by ston filling starting about 32 ft. from foot of slope and carried within about 2 ft. of top of dam, slope of earth embankment filled against being quite steep, about 1 to 2,2 to height about 22 ft., when stone wer heaped up to meet outer slope, and earth filled on. Heart-wall, puddle, 6 ft. thick, carried 2 ft below natural surface and within 1 ft. of top; this was filled against at rear with 6 ft. of gravel. When repairs were made in '78 dam was leaking; it was thought that there were two lines of leakage along inner slope, one at juncture of stone and gravel filling with earth part of embankment, other slightly above. Nearly two-thirds of stone and gravel filling at inner slope, indicated on original plan, had either never been put in, or had washed away; slope above was flattened, lower slope of dam was slightly increased, and none of the puddle wall could be found.

New or Raised and Repaired Dam: 1,018 ft. long, 35 ft. high, 25 ft. wide on top, 192 at bottom, with top 211 ft. above tide level and water 6 ft below. Raised 5 ft., water level raised 3 ft. Inner slope brought back to original shape by first, filling in over leaky and flattened part with brush, straw and fine material, then [presumably] with earth; strong, dry masonry wall, with granite coping built along top of inner slope, finished on wet side to slope of 1 to 1, and carried down face of old (settled slope) vertical distance of about 8 ft. beneath present high water, then filled against with new material to slope line. Outer slope filled against till increased to 2½ to 1, old and new part being joined by steps in old. Top has slight outward slope, and to incorporate it with old part, trench about 8 ft. wide and 5 ft deep was dug and refilled [presumably] with same material as addition to increase height. *Spillway:* at and in east end of dam, 65 ft. wide; lined with masonry, free, regulating gate not being used; slope, nearly vertical to granite platform. No pipes through dam, water being drawn from other end of lake. No leaks now. Built as above. Des. Engr. (improvements), Jno. B. Jervis, deceased. Const. Engr. (do), Chas Fairbanks. Contr., Forbes Black. Cost, originally, about $12,000; improvements, $11,000.

Supply Conduits.—First one laid from Lower Chain lake to city was 12 ins. in diam. In '56 a 15-in. pipe was added, and in '62 first one replaced by a 24-in. main. From Lower Spruce Hill lake a 20-in. main was laid for one mile, then reduced to 15 ins. and continued to a junction with the 15 in. main laid from Long lake in '57.

Oxidization of Iron Pipes: much trouble has been experienced from this cause, the incrustation varying in thickness from ⅛ to 1 in. In '76-7 about 7 miles of 3-in. pipe were cleaned by hand scrapers at a contract price of 14.3 cents for 1 lin. ft. In '30 the part of 12-in. supply mains laid in '48, and retained in the city, was cleaned by

a self-acting machine, and since more pipe has been cleaned, all with good success. The scraper was inserted in the pipe, and carried forward by the flow of water for from ¾ to 2 miles, sweeping all accumulations before it, including rust, stones, pieces of broken pipe and of lead. For description of the process, with illustrations, see paper by E. H. Keating, in Trans. Am. Soc. C. E., vol. XI., pp., 125 to 150. In year '87-8 12¾ miles of pipe was cleaned (all but 3,213 ft 2 and 3 ins.) by mechanical scrapers at total cost of $226.13. Sizes and lengths were as follows: 8½ miles 24 and 15 in. low and high service supply mains, 21,025 ft. 15 and 12-in. mains, 3,213 ft. 2 and 3-in. pipe by hand scrapers.

Distribution.—*Mains*, c. i., 60 miles; that used in construction was from Scotland. *Services*, lead. *Taps*, 5,300. *Meters*, 6. *Hydrants*, now made by city, 333. *Valves*, kind, do.

Consumption, 6,000,000 galls. *Pressure*, 10 to 60 lbs.

Financial.—Cost, $850,000. Debt, $800,000. Int., 4½ to 6%. Ann. op. exp., about $15,000. Ann. rev.: consumers, $66,000, including that from army and navy.

Management.—Board of Works. Chn., Saul Mosher. Supt. and Engr., E. H. Keating.

KENTVILLE, *Kings Co.* (Pop., 1,779; est., 3,000.) On Cornwallis river. Incorp. No sewers. Has electric lights.

History.—Built in '87 by city. Engrs., Crafts & Forbes, Boston, Mass. Contr., Wm. Sutherland, Kentville.

Water Supply.—Mill brook, by gravity to reservoir.

Reservoirs.—Cap., 3,500,000 galls.; a 3,000,000 gall. and a 500,000 gall. reservoir.

Distribution.—*Mains*, c. i., 6½ miles; from Black & Co., Glasgow, Scotland. *Taps*, 115. *Meters*, none. *Hydrants*, Chapman, 29. *Valves*, Chapman.

Consumption, not given. *Pressure*, 100 lbs.

Financial.—Cost, $30,000. Debt, $30,000. Int., 5%. Ann. op. exp., not given. Ann. rev.: consumers, $750.

Management.—Com. of Town Council. Secy., Wm. Eaton. Supt., W. L. Bishop.

NEW GLASGOW, *Pictou Co.* (Pop., 2,595; est., 4,500.) Has coal and ship-building, glass, iron, steel and wood working industries. Incorp. town. No sewers. Has electric lights.

History.—Built in '87-8 by town; put in operation, Nov. '88. Engr., Wm. Kennedy, Owen Sound, Ont.

Water Supply.—East River, pumping to reservoir.

Pumping Machinery.—Dy. cap., 500,000 galls ; Blake or Knowles.

Reservoir —Cap., 2,000,000 galls. Contrs., Stewart & McDonald, New Glasgow.

Distribution.—*Mains*, 12-in., down, iron, 8½ miles; from Thos. Edington & Sons, Glasgow, Scotland; trenching and pipe-laying down by Stewart & McDonald, New Glasgow. *Services*, lead, iron. *Taps*, 250. *Meters*, Worthington. 5. *Hydrants*, Mathews, 37.

Consumption, 80,000 galls. *Pressure:* Ordinary, 97 lbs. Fire, 105 lbs.

Financial.—Cost, $71,000. Debt, $70,000. Int., 4½%. Ann. op. exp., $3,500. Ann. rev.: consumers, $4,500.

Management.—Town Clerk, A. M. Fraser. Supt., Dan'l Ormiston. Report, Jan. 29, '89.

PICTOU, *Pictou Co.* (Pop., 3,403; est., 4,000.) At head of Pictou harbor. Has lumber and ship-building industries.

NOTE.—A 1,000,000-gall. comp. Worthington pump was contracted for in '89. No further data.

TRURO, *Colchester Co.* (Pop., 3,512; est., 6,000.) At head of Cobequid bay. Has manufactories. Incorp. in '75. No sewers. Has electric lights.

History.—Built in '75 by town. In '88-9 works were enlarged and remodelled after plans by E. H. Keating, Halifax.

Water Supply.—Surface water, by gravity and direct pumping. Eventually, gravity system will entirely supersede pumping system, but both are now in use.

Reservoir.—Cap., about 2,500,000 galls.; about 90x1,200 ft.; av. depth, 6 ft.

Pumping Machinery.—Dy. cap., unknown; two Holly rotary. *Boilers:* two upright, quick steaming.

Distribution.—*Mains*, c. i., 7 miles. *Services*, galv. i., cnam. i., lead. *Taps*, 400. *Meters*, none. *Hydrants*, Holly, 43. *Valves*, Eddy.

Consumption, not given. *Pressure:* Ordinary, 63 to 75 lbs. Fire, 103 lbs.

Financial.—Cost, $47,000. Debt, $36,000. Int., 5%. Ann. op. exp., $1,100. Ann. rev.: total, $2,000.

Management.—Chn.. S. J. Chambers. Clerk, W. D. McCollum. Engr., A. L. Archibald.

WINDSOR, *Hants Co.* (Pop., 3,000; est., 3,500.) On Avon river, near quarries of limestone and gypsum. Engaged in ship-building and manufacturing cotton, iron and woolen goods. Incorp. town in '78. Sewers under survey in '90. Has electric lights.

History.—Built in '83 by town. Engr., E. H. Keating, Halifax. Labor mostly done by the day.

Water Supply.—Brook, by gravity from impounding reservoir.

Dam and Reservoir.—Area, 5 acres; 185 ft. above hige tide. Dam. of wood. 128 ft. long, 17 ft. high.

Distribution.—*Mains*, c. i., 11 miles; imported from Scotland. *Services*, w. i., lead. *Taps*, 500. *Meters*, none. *Hydrants*, designed by E. H. Keating, 45.
Consumption, not given. *Pressure*, 86 lbs.

Financial.—Cost, $54,000. Debt, $52,000. Int., 5%. Sinking fund, $3,300. Ann. op. exp., $350. Ann. rev.: consumers, $3,700.

Management.—Chn. Com., Jas. E. Graham. Supt. G. Parker Smith.

WOLFVILLE, *Kings Co.* (Pop., 900; est., 1,000.) Is 7 miles from Kentville. No sewers or electric lights.

History.—Built in '89-90 by town; expected to have in operation, July, '90. Engrs., Price & Butler.

Water Supply.—Duncan's brook, by gravity from impounding to distributing reservoir. Source on N. side Gaspereau Mt. No filtration.

Dam and Impounding Reservoir.—Cap., 100,000 galls. No further data.

Distributing Reservoir.—Cap., 2,225,000 galls. Contrs., Geo. & Levi D. Brown, Windsor.

Distribution.—*Mains*, 8 to 4-in. iron, about 5 miles. *Services*, ¾ and ½-in. enam. l. Pipe from Londonderry Iron Works; specials from J. S. Fleming, St. John, N. B.; trenching and pipe-laying done by Geo. & Levi Brown, Windsor.
Pressure, 75 lbs.

Financial.— Cost, est., $25,000. Bonded debt, $25,000; 20-years. Int., 4½%.

Management.—Three Comrs. Chn., Fred. Brown, Geo. V. Rand, D. A. Munro. Secy. and Treas., A. De W. Barss. Report, Mar. 7, '90.

YARMOUTH, *Yarmouth Co.* (Pop., 3,500; est., 7,000.) At entrance of Bay of Fundy. Has manufactories. Incorp. Has "imperfect" sewerage system and electric lights.

History.—Built in '81 for domestic supply by Yarmouth Water Co. Des. Engr., E. Wasell. Contrs., Inman Bros., N. Y. City.

Water Supply.—Lake George, by gravity. Lake 9 miles long, has av. width of 1¼ miles; 150 ft. above town.

Distribution.—*Mains*, c. i., 21 miles. *Services*, lead. *Taps*, 1,158. *Meters* and *Hydrants*, none. *Pressure-recording gauge*, Edson.
Consumption, 500,000 galls. *Pressure*, 37 lbs.

Financial.—Cost, $217,000. Cap. stock, $200,000. Bonded debt, $200,000. Int., not given. Ann. op. exp., $1,500. Ann. rev.: consumers (in '87), $6,500; city, none.

Management.—Prest., Hugh D. Cann. Secy., Geo. Bingay. Supt., Geo. H. Robertson.

Water-Works Projected with Fair Prospects of Construction.

DARTMOUTH, *Halifax Co.* (Pop., 4,358.)

Proposed Works.—Apr. 26, '89, building of works postponed one year, proposition to bond town for water and sewerage to amount of $100,000 having been defeated. Town Clerk, A. Elliot. See MANUAL for '88, p. 543.

PRINCE EDWARD ISLAND.

Water-Works Completed.

CHARLOTTETOWN, *Queens Co.* (Pop., 11,485; est., 12,000.) On Hillsborough river, with good harbor. Engaged in manufacturing and trade. Incorp. No sewers. Has electric lights.

History.—Built in '88-9 by city. Des. Engr., M M. Tidd. Asst. Engr., Freeman C. Coffin. Both of Boston, Mass. Contrs., J. W. Mackintosh, Stellarton, J. K. McDonald, New Glasgow and Wm. H. Frazer, Charlottetown.

Water Supply.—Surface well, pumping to reservoir. Well 25 to 30 ft. from Three Mile brook, which has a drainage area of about 900 acres; 25 ft. in diam., about 20 ft. deep; carried to rock; lined for 19 ft. in height with rough blocks of Nova Scotia grey sandstone, laid loose, and backed with broken stone; upper part of wall, brick in Portland cem. mortar. Well has overflow.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; Blake.

Force Main.—C. i., 14-in., 4,722 ft. long.

Reservoir.—Cap., 2,000,000 galls.; in excavation and embankment, 135 ft. in diam. at bottom, 186 at top, 17 ft. deep. Banks built in 6-in. layers, wet and rolled; 15 ft. wide on top; slopes, 1½ to 1; inner paved with 12 ins. of dry stone on 9 ins. of broken stone backing, which in turn is on 2 ft. of puddle to vertical height of 8 ft. from bottom; lower course, 21 ins. thick, extending through broken stone, and resting on concrete. Bottom covered with 4 ins. sand, then 2 ft. puddle, which extends up inner slope to vertical height of 8 ft., then horizontally 1½ ft. beyond center of embankment. *Heart-wall:* rubble masonry in Portland cem. mortar, 2 ft. thick, 6 ft. high, plastered on inside with 1 in. of mortar; founded on puddle. *Gate-house:* hard brick, 11 x 15 ft. Two screens, 16 meshes to 1 in. Engrs. and Contrs., see History.

Distribution.—*Mains,* 14 to 6-in. c. i., 15 miles; from R. Laidlaw & Son, Scotland; trenching and pipe-laying done by McIntosh & McDonald, New Glasgow, N. S. *Services,* lead. *Taps,* 450. *Meters,* 1. *Hydrants,* Galvin, 87. *Valves,* Galvin. *Consumption,* about 75,000 galls. *Pressure:* Ordinary, 58 lbs. Fire, 85 lbs.

Financial.—Cost, $153,000. Debt, $153,000, Int., 5%.

Management.—Comrs. Chn., David Laird. Secy. and Treas., Duncan Mc Lean. Supt., Chas. Dalziel.

NEWFOUNDLAND.

Water-Works Completed.

CARBONEAR, (Pop., 3,000; est., 5,300.) Incorp. Has sewers. No electric lights.

History.—Built in '83-4 by Carbonear Water Co. Engr., Jno. Martin, St. John's. Contrs., Jno. Martin and Jno. Foote, Carbonear.

Water Supply.—A small lake by gravity. Lake is 4 miles from town, and 350 above sea.

Tank.—Is 3½ x 5½ ft., x 7½ ft. deep.

Distribution.—*Mains,* 16 to 4-in. c. i. *Services,* lead. *Taps,* 43. *Meters,* none. *Hydrants,* 19.

Consumption, not given. *Pressure:* Ordinary, 110 lbs. Fire, 150 lbs.

Financial.—Cost, est., $60,000. Bonded debt, $34,000. Int., 4%. Sinking fund, $500. Ann. op. exp., $1,800. Ann. rev.: consumers, $2,000; city, $1,360. Hydrant rental, "8% on valuation of property," which is appraised at $17,000.

Management.—Prest., B. T. H. Gould. Secy. and Supt., Jas. P. Guy.

HARBOR GRACE, *District of Harbor Grace.* (Pop., 6,770; est., 9,000.) On Conception bay.

History.—Built in '63 by Co.

Water Supply.—Bannermann lake, by gravity.

Distribution.—(In '84.) *Mains,* c. i., 5 miles. *Services,* lead. *Taps,* 102 *Meters,* none. *Hydrants,* 38.

Financial.—(In '84.) Debt, $52,400. Int., 5%.

Management.—(In '84.) Secy., C. Watts.

NOTE.—Requests for information have been ignored since '84.

HEART'S CONTENT, (Pop., 880.) Is 12 miles from Carbonear.

NOTE.—Built by Anglo-American Telegraph Co., who have built up village. No further data.

SAINT JOHN'S, *District of St. John's.* (Pop., 21,000; est., 39,000.) On coast.

History.—Built in '59 to '62 by city. Des. Engr., A. Fourman. Const. Engr., J. Martin.

Water Supply.—Pond, by gravity. Area of pond, 1,350 acres; elevation above the city, 500 ft.

Distribution.—(Nov. 5, '88.) *Mains*, c. i., 20 miles. *Services*, lead. *Taps*, 1,850. *Meters*, none. *Hydrants*, Landbetter's patent, Glasgow, 162.

Consumption, 3,500,000 galls. *Pressure*, 200 lbs.

Financial.—Cost (in '86), $412,000. Debt, $400,000. Int., 4%. Ann. op. exp., $7,200. Ann. rev.: consumers (in '86), $20,900; in '88, "5% on rent."

Management.—Chn., J. Goodfellow. Supt., J. Hays. Report by J. Martin.

GROUP 10.—CANADA: INTERIOR and WESTERN PROVINCES.—Water-Works Completed, in Process of Construction or Projected, in Quebec, Ontario, Manitoba, Northwest Territory and British Columbia.

QUEBEC.

Water-Works Completed or in Process of Construction.

BEAUHARNOIS, *Beauharnois Co.* (Pop., 1,449; est., 1,800.) Has electric lights.

General Description.—Under construction first half of '90 by town. Chf. Engr., J. E. Vanier. Asst. Engr., Jos. Laurin. Both of 107 St. James St., Montreal. Labor by the day. Supply, St. Lawrence river, pumping direct. Intake of 8-in. flexible pipe, 1,800 ft. long, laid in winter in 4½ days, through ice. River end will be protected by crib 22 ft. sq., 13 ft. deep. Est. cost, $30,000; raised by bonds. Report, Mar. 17 '90.

BERTHIER, *Berthier Co.* (Pop., 2,156.) On St. Lawrence river. Incorp. Has electric lights.

History.—Built in '79 by J. U. Foncher.

Water Supply.—St. Lawrence river, pumping to tank and direct.

Pumping Machinery.—Dy. cap., not given; two Worthington.

Tank.—Cap., about 57,000 galls.; 27 x 13 ft., 40 ft. above the ground.

Distribution.—(Approximately.) *Mains*, c. i., 3 miles. *Services*, lead. *Taps*, 300. *Meters*, none. *Hydrants*, 15.

Consumption, not given. *Pressure:* Ordinary, 20 lbs. Fire, 100 lbs.

Financial.—(Approximately.) Cost, $22,000. Debt, not given. Ann. op. exp., $1,000. Ann. rev: consumers, $2,400; city, none.

Management.—Owner, J. U. Foncher. Supt., Gordien Coutu.

NOTE.—No changes are reported for '89.

COTE SAINT ANTOINE, *Montreal Co.* (Pop., est., 1,500.) A suburb of Montreal. Settled about '81; now an incorp. town. No sewers. Has electric lights.

History.—Built in '83 by Cote St. Antoine Water Co. Engr. and Contr., J. B. A. Béique.

Water Supply.—Montreal water-works, through meter. In '84, price was $0.40 per 1,000 galls.

Distribution.—*Mains*, c. i. 3 miles. *Services*, lead. *Taps* (in '87), 170. *Meters*, 180. *Hydrants*, 4.

Consumption, 12,000 galls. *Pressure*, 25 to 30 lbs.

Financial.—Cost, $19,040. Cap. stock, authorized, $20,000; paid up, $5,840. No bonds. Debt, $3,000. Ann. op. exp., $908. Ann. rev.: consumers, $2,879; city, $330 for water used at fires and in sprinkling streets.

Management.—Prest., A. C. Hutchinson. Secy., Treas. and Gen. Mgr., Fred W. Evans.

DRUMMONDVILLE, *Drummond Co.* (Pop., 2,000.) Incorp. town in '88. No sewers or electric lights.

History.—Built in '87-8 by Comtois & Poirier.

Water Supply.—St. Francis river, pumping to reservoir and tanks.

Pumping Machinery.—Dy. cap., 36,000 galls. Contrs., E. A. Roudeau, Sorel, P. Q. *Boiler:* tubular, 4 x 12 ft.

Reservoir.—No data.

Tanks.—Each 12 x 6 ft.

Distribution.—*Mains*, wooden, 3 miles; from Jos. La Chappelle, St. Jerome. *Services*, wood and lead. *Taps*, 90. *Meters*, none. *Hydrants*, 12.

Consumption (in '87), 8,000 galls. *Pressure*, 40 lbs.

Financial.—Cost, $7,000. Debt, $5,000. Int., 8%. Ann. op. exp., $150. Ann rev.: consumers, $800; city, none; C. P. Ry. and Drummond Co., $200.

Management.—Owners, Comtois & Poirier.

HULL, *Ottawa Co.* (Pop., 6,668; est., 13,000.) On Ottawa river, opposite Ottawa, Ont. Has manufactories. Incorp. No sewers or electric lights.

History.—Built in '85 by town. Engr Robt. Surtees, Ottawa, Ont. Contrs., Geo. H. Miller & Theophile Viau, Hull. In '89 $30,000 were to be expended in improvements, including mains, pump and pump-house.

Water Supply.—Ottawa river, at head of Chaudiere falls, pumping to tank and direct.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Knowles. Additional Knowles projected in '89.

Tank.—Cap., 18,000 galls.

Distribution.—*Mains*, c. i., 6½ miles. *Services*, lead. *Taps*, 996. *Meters*, none. *Hydrants*, 47.

Consumption, 1,000,000 galls. *Pressure:* Ordinary, 75 to 80 lbs. Fire, 90 lbs.

Financial.—Cost, $118,000. Debt, $110,000; bonded debt, $110,000. Int., 5%. Sinking fund, $2,700. Ann. op. exp., $5,400. Ann rev.: consumers, $11,000.

Management.—Prest., Geo. J. V. Arduin. Secy. and Treas., J. C. Laferriere. Supt., Ludger Genest.

IBERVILLE, *Co. not given.* (Pop., 1,847.) Incorp. town. No sewers or electric lights.

History.—Built in '81 by town. No. Engr. Contrs., Beauchemin & Son, Sorel.

Water Supply.—Richelieu river, pumping direct.

Pumping Machinery.—Dy. cap., not given; from Contrs.; 12 x 18-in. steam, 7-in. water cylinders.

Ditribution.—*Mains*, 8-in., down, 5 miles; from Glasgow, Scotland. *Services*, lead. *Taps*, 575. *Meters*, none. *Hydrants*, made by Contrs., 20.

Consumption, 140,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—Cost, $33,000. Debt, $17,000. Int., 6%. Sinking fund, 2% per annum. Ann. op. exp., $1,500. Ann. rev.: consumers, $3,000.

Management.—Three Comrs. Secy. and Treas., J. A. Nadeau. Report by L. Biron; date, June 20, '89.

JOLIETTE, *Joliette Co.* (Pop., 3,268; est., 4,000.) On L'Assomption river, on level ground. Has manufactories. Settled in '40; incorp. village in '43; town in '68. Has sewers and electric lights.

History.—Built in '73 by town, and rebuilt or extended in '81. Engr., E. N. Chaumette. Contrs., Beauchemin & Sons, Sorel.

Water Supply.—L'Assomption river, by direct pumping.

Pumping Machinery.—Dy. cap., 300,000 galls.; 7-in. rotary water-power pumps built by Dayone & Deblois, and a 7½-in. dup. pump, built by Beauchemin & Sons, Sorel.

Distribution.—*Mains*, 8 to 4-in. c. i., 7 miles; from James Robinson, Montreal. *Services*, lead. *Taps*, 2,000. *Meters*, none. *Hydrants*, 32.

Consumption, 150,000 galls. *Pressure:* Ordinary, 50 lbs. Fire, 80 lbs.

Financial.—Cost, $50,000. Debt, $50,000. Int., 5%. Ann. op. exp., $1,000. Ann. rev.: consumers, $6,000.

Management.—Prest. of Com., A. Fontaine. Supt., Pierre Laforest.

LONGUEUIL, *Chambly Co.* (Pop., 2,445; est., 3,500.) On St. Lawrence river, opposite Montreal. Incorp. in '74. Partially sewered. No electric lights.

History.—Built in '76 by town.

Water Supply.—St. Lawrence river, by direct pumping.

Intake and Pump Well.—A 22-in. pipe conveys water to pump-well 10 ft. in diam., 32 ft. deep.

Pumping Machinery.—Dy. cap., 750,000 galls.; one built by Waterous Co. Brantford, Ont., and one from Beauchemin & Sons, Sorel. Latter is of Worthington type.

Distribution.—*Mains*, c. i., 7¼ miles. *Services*, lead. *Taps*, 560. *Meters*, none. *Hydrants*, 43.

Consumption, 120,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—Cost, $80,000. Debt, $80,060. Int., 6%. Ann. op. exp., $2,000. Ann. rev.: consumers, $5,450.

Management.—Secy. and Treas., L. E. Bourgeois. Supt., J. A. Gariepy.

MONTREAL, *Montreal Co.* (Pop., 140,682; est., 200,000.) On island at confluence of Ottawa and St. Lawrence rivers, on gentle slope at foot of a mountain rising 750 ft. Founded by French in 1642. Has sewers and electric lights.

History.—Now owned by city, original works having been built by Co. in '01, sold to a second Co. in '16, to third in '32 and to city in '45. In '53-6 city built the new works. Engrs. for new works: Thos. C. Keefer, Ottawa, Ont., and Louis Lesage, Montreal, with W. J. McAlpine and Jno. B. Jervis as Consult. Engrs. Louis Lesage was Supt. and Engr. from '53 to the time of his death in '89. *For description of works from '01 to '53, see* MANUAL *for '88, p. 545.*

Water Supply.—St. Lawrence river, through canals to pumps, thence by pumping to reservoirs and direct. Supply introduced in '53-6 is from point one mile above Lachine rapids at elevation of 37 ft. above summit level of Montreal harbor.

Canal.—First one is 1¾ miles long, 20 ft. wide at bottom, 40 at top, 8 ft. deep, and has grade of 2½ ft. per mile. In '56 it was found that original sectional area of canal had been considerably reduced by slides in banks.

In '74 new canal was begun, after plans by Louis Lesage, approved by Wm. J. McAlpine. It is 60 ft. wide at bottom, 148 at top, 13 ft. deep, has side slopes of 3 to 1, and falls 3 ins. to mile. In '78, 4,800 ft. of this canal was completed, it connecting with old one at that distance from river.

In first canal backwater and anchor ice caused much trouble, and for several winters a channel had to be cut through ice in entrance to channel. Entrance was deepened in '63, doing away with anchor ice, but ice in canal reduces its capacity one-third.

Present canal or aqueduct, leading from St. Lawrence to pumps, is 5 miles long.

Pumping Machinery.—Dy. cap., 30,500,000 Imp., or about 36,500 000 U. S. galls., with additional 3,000,000 imp., or about 3,500,000 U. S. galls. for high service. Both water-power and steam are used to drive pumps, 14% of water used in '86 having been pumped by steam. Water-wheels were built by Wm. Fairbairn & Son, Manchester, Eng., Jno. McDougal, Montreal, and W. P. Bartley & Co., Montreal. Engines were built by W. E. Bartley & Co., and E. E. Gilbert, both of Montreal, and Henry R. Worthington, N. Y. City.

In '56 two breast water-wheels were put in use, each 20 ft. in diam., 22 ft. wide, working under 20-ft. head and fall. In '64 turbine wheel was added, and in '74 one of old breast wheels was replaced by second turbine.

In '75 a 500,000 Imp. gall. Worthington pump was put in at McTavish St. reservoir. In '89, new pumps with dy. cap. of 3,500,000 Imp. galls. were put in operation.

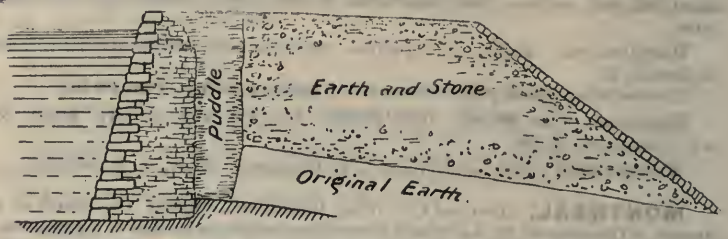
In '72 a comp. engine was added, having 44 and 26-in. cylinders. In '73 a dup. high-pressure engine was connected with first turbine for use in winter months. In '74 an 8,000,000 Imp. and in '85 a 10,000,000-gall. (Imp.) Worthington pump was added, and in '88 a Gilbert pump was put in operation, having a contract cap. of 2,000,000 Imp. galls.

Reservoirs.—*McTavish St. Low Service:* cap., 35,000,000 imp., or about 43,000,000 U. S. galls.: on McTavish St., about 200 ft. above harbor; area, 5.83 acres; irregular in shape; excavated in rock, with bank in front, as shown in accompanying illustration. *Discharge-pipes:* two 24-in. Does not leak. Built in '56 with cap. of 15,000,000 galls.; enlarged to present size 62-78. Engr., see History. Contr., —— Shaler, for original, —— Whelan, for enlargement.

High Service: cap., 1,570,000 imp., or 1,880,000 U. S. galls.; built in '75 at head of Peel St., and is 80 x 200 ft., x 10 ft. deep, at 230 ft. above the low service reservoir, or 530 ft. above the harbor.

Distribution.—*Mains*, c. i., 161 miles. *Services*, lead. *Taps*, 34,643. *Meters*, 621. *Hydrants*, kind not given, 1,207.

Consumption, 13,240,300 imp., or about 15,650,000 U. S. galls. *Pressure*, 30 to 80 lbs.



Cross-Section, Embankment, McTavish St. Reservoir, Montreal, P. Q.

Financial.—Cost, $6,645,627. Debt (in '86), $6,000,000. Int., 7, 6, 5 and 4%. Ann. op. exp., $91,569. Ann. rev.: consumers, $591,873.

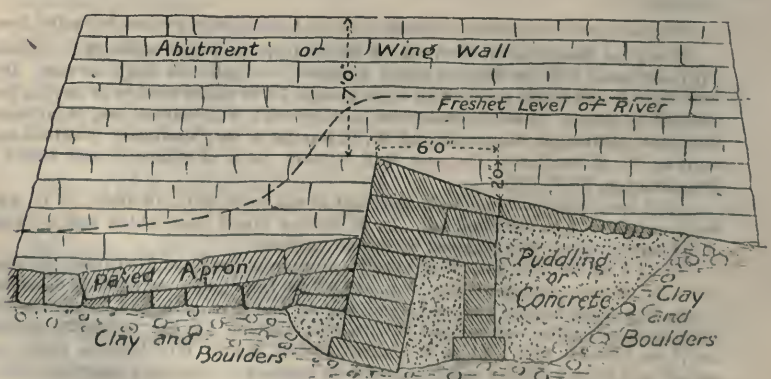
Management.—Acting Supt, B. D. McConnell. Pumping Engr., D. Kearney.

QUEBEC, *Quebec Co.* (Pop., 62,447; est., do.) On St. Lawrence River, on promontory at mouth of St. Charles river. Point called Cape Diamond is 333 ft. above river. Upper town is on elevated table land, and lower on narrow belt along St. Lawrence, backed by cliff and strip on St. Charles 2,000 ft. wide, of more gradual ascent. Founded in 1608; incorp. city in '41. Has sewers and electric lights.

St. Sauveur, having pop. of 16,000, was (Aug., '89) about to be annexed to Quebec, one of the conditions being the introduction of water there.

History.—Built in 51-3 by city, when pop. was about 40,000, and new works built in '82. Des. Engr. of former, Geo. R. Baldwin, deceased; latter, C. Baillargé, who has been Supt. and Engr. since '66. Contr. for new works, H. T. Beemer.

Water Supply.—St. Charles river, by gravity. Dam across river at Lorette, 8 miles from city, forms reservoir, from which conduit leads to city. Head of water at reservoir is 486 ft. above base, or high spring tides of St. Lawrence river. About 3 miles above dam river widens into Lake St. Charles. Drainage area of river above dam is 112 sq. m.



Dam Across St. Charles River at Lorette, Quebec Water-Works.

Dam and Reservoir.—Cap., est., 100,000,000 galls.; area, 34 acres; backs water about 3 miles. Dam, 200 ft. long, of masonry, with over-fall entire length; for other dimensions and general character, see accompanying section. *Discharge-pipes:* two, original 18-in., and 30-in. laid in '83; slope, 0 63 in 100. *Culvert:* diam., 5 ft. No leakage except through joints of upper layer of cut stone, caused by disintegration of cem. joints by action of frost and water. Built in 51-3. Engr., see History. Contr., Joseph Archer, Quebec. Cost, including gate-house, $33,000.

Supply Conduit.—In '81 this consisted of 40,939 ft. of 18-in. c. i. pipe, in 9 ft. lengths, with bell and spigot joints run with lead, lead staved, as in some parts pressure is 200 lbs.; thickness of pipe varies with pressure from 1¼ to ⅞ ins. In '83, a 30-in. main was laid beside the 18-in. pipe, with C. Baillargé as Engr.

River Crossing and leak in same.—Near city conduit crosses St. Charles river by means of pipe-arch bridge of 120-ft. span, pipe being surrounded by wood.

Originally pipe was embedded in concrete and timber, 5 ft. below low water. In '72 it was found that lead joint had blown out, and that there was a hole 1½ ins. in diam. in spigot end of pipe at that joint; jet from this hole was under pressure of 210 lbs., and had cut 3 ins. into wooden box and nearly through a 7-in. post. Pipe was repaired by banding it with c. i. sleeve with a lead joint. Within a year a hole 2 ins. wide had been cut through sleeve, and defective pipe was thereafter cut out and replaced.

Waste of water and incrustation in pipe.—As early as '60, complaints of an insufficient supply were made, and experiments afterwards afterward conducted by Thomas C. Keefer, showed excessive waste, lowest av. night delivery in April being 88% of the highest average day delivery.

Supply was also diminished by tubercular formation in pipes. In '65, G. R. Baldwin found that supply conduit was practically reduced from 1.5 to 1.28 ft. in diam., by incrustation.

Distribution.—*Mains*, c. i., 33 miles. *Services*, lead. *Taps*, 6,119. *Meters*, none. *Hydrants*, Chapman, 251. *Valves*, Chapman.

Consumption, 10,000,000 galls. *Pressure*, 83 lbs.

Financial.—Cost, $2,000,000. Debt, $1,750,000. Int., 6%. Ann. op. exp., about $25,000. Ann. rev.: consumers, $143,000.

Management.—Com. from City Council. Engr. and Supt., C. Baillargé.

NOTE.—In *Eng. News*, Vol. V., pp. 148, 156, 163, 173, there are lengthy extracts from the Report of Preliminary Examination made by the Engr., Geo. B. Baldwin, to the Mayor of Quebec, Apr. 3, '48, regarding the introduction of a water supply, and also a description of the works, as they were in '78, by Chas. Baillargé, the Engr. The papers contain many interesting facts, and are accompanied by a sheet of drawings from illustrations accompanying Mr. Baldwin's report, showing the route, profile and details of the conduit as then proposed, and also the gate-house and dam.

RICHMOND, *Richmond Co.* (Pop., 1,200; est., 2,500.) On St. Francis river in manufacturing and slate-quarrying district. Incorp. town. No sewers or electric lights.

History.—Built in '82 by Lafontaine & Roussin, Boyton Falls, under 25-years franchise. No Engrs. or Contrs.

Water Supply.—Source not given; by gravity from reservoir.

Reservoir.—Area, ½ acre.

Distribution.—*Mains*, c. i., 3 miles. *Services*, w. i., lead. *Taps*, 225. *Meters*, none *Hydrants*, 12.

Pressure, about 50 lbs.

Financial.—Cost, $16,000. Cap. stock, $16,000. No debt. Ann. op. exp., $180. Ann. rev.: consumers, $1,800. Hydrants free.

Management.—Owners, Lafontaine & Roussin, Boyton Falls. Report, Sept. 11, '89.

SAINTE CUNEGONDE, *Hochelaga Co.* (Pop., 9,500.) Near Montreal, on St. Lawrence river. Settled in '74; incorp. city in '83. Has sewers and electric lights.

History.—Built in '79 by Berger & Béique, who also did work. Des. Engr., J. A. Beaudry.

Water Supply.—St. Lawrence river, by direct pumping. Supply for St. Henri is drawn from this system.

Intake.—Stone crib, 75 ft. long, 32 ft. wide and 25 ft. deep extends into river to 23 ft. of water. In its center there is a gate chamber 6 ft. sq., from which a wooden flume 3½ ft. in diam. conveys water 1,964 ft. to pump-well of stone in cem., 8 ft. in diam., 32 ft. deep. Flume is of red pine staves, each 4 ins. wide and thick, nailed every 4 ins. with 3-in. copper nails. Every 4 ft. the flume is hooped with ½ x 3-in. iron, bolted on.

Pumping Machinery.—Dy. cap., 3,000,000 galls. In '84 a 500,000 Holly quadruplex was in use.

Distribution.—*Mains*, 12 to 4-in. c. i., 11½ miles. *Services*, lead. *Taps*, 1,525. *Meters*, 8. *Hydrants* 18.

Consumption, 250,000 galls. *Pressure:* Ordinary, 50 lbs. Fire, 75 lbs.

Financial.—Cost, $175,000. Ann. op. exp., withheld, est., $1,200. Ann. rev.: consumers, $20,000; city, $1,132. Hydrant rental, $70.

Management.—Secy., Chas. F. Porlier.

SAINT HENRI, *L'Assomption Co.* (Pop., 700; 11,000.) Suburb of Montreal. Settled in '72; incorp. city in '73. Has sewers and electric lights.

History.—Built in '80 by Berger & Béique, without Contrs.

Water Supply.—Berger & Béique's system at Ste. Cunegonde.

Distribution.—*Mains*, c. i., 16 miles. *Services*, lead. *Taps*, 2,575. *Meters*, 12. *Hydrants*, 36.

Consumption, 375,000 galls. *Pressure:* Ordinary, 50 lbs. Fire, 75 lbs.

Financial.—Cost, $155,000. Ann. op. exp., withheld. Ann. rev.: consumers, $2,300.

Management.—Secy., Chas. F. Porlier, St. Cunegonde.

SAINT HYACINTHE, *Saint Hyacinthe Co.* (Pop., 5,321; est., 10,000.) On Yamaska river. Engaged in manufacturing. Incorp. Has sewers and electric lights.

History.—Built by St. Hyacinthe Water-Works Co., date not given.

Water Supply.—Yamaska river, by direct pumping.

Pumping Machinery.—Dy. cap., 1,800,000 galls.; one Knowles, one Blake.

Distribution.—*Mains*, c. i., 20 miles. *Services*, lead. *Taps*, 1,000. *Meters*, none. *Hydrants*, Chapman, 55.

Consumption, 650,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 70 lbs.

Financial.—Cost, $141,000. Cap. stock, $50,000. Debt, not given. Int., 6%. Ann. op. exp., $4,000. Ann. rev.: consumers, $11,500; city, $600.

Management.—Prest., Louis Cote. Secy., Jos. Nault. Supt., M. A. Connell.

SAINT JOHN'S, *Saint John's Co.* (Pop., 4,314; est., 5,500.) On Richelieu river. Incorp. Has sewers and electric lights.

History.—Built in '72 by Louis Molleur's Sons. Contrs., Jno. McDougal, Montreal, and Beauchemin & Sons, Sorel.

Water Supply.—Richelieu river, pumping direct and to reservoir.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; 3 dup. steam, two 8½x17x7 ins., one 12x15x10 ins.; also one 7-in. water power. All from Jno. McDougal, Montreal. Last named steam added in '89.

Reservoir.—Cap., 27,000 galls.; 24 ft. in diam., 8 ft. deep.

Distribution.—*Mains*, c. i., 16¼ miles; imported from Glasgow, Scotland. *Services*, lead. *Taps*, 950. *Meters*, 12. *Hydrants*, 50.

Consumption, 750,000 galls. *Pressure:* Ordinary, 45 lbs. Fire, 100 lbs.

Financial.—Cost, $130,000. No debt. Ann. op. exp., $1,500. Ann. rev.: consumers, $9,700; city none.

Management.—Owners, Louis Molleur's Sons. Supt. (in '88), P. L. Henreuex.

SHERBROOKE, *Sherbrooke Co.* (Pop., 7,227; est., 8,000.) At junction of Magog and St. Francis rivers, which afford water-power. Has various manufactories. Incorp. Has sewers and electric lights.

History.—Built in '80-1 by Sherbrooke Gas and Water Co. Engr. and Contr., A. O. Granger Philadelphia, Pa.

Water Supply.—Magog river, pumping to reservoir. River is outlet of Lake Memphremagog.

Pumping Machinery.—Dy. cap., 700,000 galls; two 14 x 16-in. Knowles water power. *Water-wheels:* two 54-in. turbines, working under 8 ft. head.

Reservoir.—Cap., 3,500,000 galls; 210 ft. sq., 21 ft. deep, in excavation and embankment, two sides rock, other two, natural soil and clay; no heart-wall. Banks 22 ft. high, 16 ft. wide at top, 76 at bottom, water, 1 ft. from top. Slopes about 1.36 to 1, inner faced with loose stone, where of earth.

Influent and Effluent Pipe: 12-in. "Not any leak" in dam. Built in '80. Engr. and Contr., see History. Cost, $21,000.

Distribution.—*Mains*, c. i., 8¼ miles; imported from Glasgow, Scotland. *Services*, lead. *Taps*, 400. *Meters*, 7. *Hydrants*, 57.

Consumption, 300,000 galls. *Pressure*, 70 lbs.

Financial.—Original cost of gas and water-works was $150,000; cost, Jan. 1. '89, including electric light plant, $200,000. Cap. stock (in '88), $200,000, including gas and water-works. Debt, $35,000. Ann. op. exp., not given, est., $1,500. Ann. rev.: consumers, $7,000; city, $1,400. Hydrant rental, $30.

Management.—Prest., R. N. Hall. Secy., E. F. Waterhouse. Supt., Andrew Sangster.

SOREL, *William Henry Co.* (Pop., 5,792; est., 7,500.) On St. Lawrence, at mouth of Richelieu river, on level ground. Settled in 1785. Incorp. city in '60. Has sewers. No electric lights.

History.—Built in '72-3 by town. Engrs., Beauchemin & Sons, Sorel.

Water Supply.—Richelieu river, by direct pumping.

Pumping Machinery.—Dy. cap., 4,000,000 galls.; water-power pumps are reported for '88, but first two pumps were driven by steam, and had 12-in. steam and 8-in. water cylinders, while in '77 a Worthington dup. with 18-in. steam and 10-in. water cylinders was added. Some of pumps were made by Beauchemin & Sons, Sorel.

Distribution.—*Mains*, c. i., w. i., 12 miles. *Services*, lead. *Taps*, 1,654. *Meters*, none. *Hydrants*, 89.

Consumption (in '87), 1,300,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 120 lbs.

Financial.—Cost, $80,000. Debt, $10,000. Int., 6%. Ann. op. exp. (in '87), $3,500. Ann. rev.: total, $8,549.

Management.—Com. Secy. and Treas., Jno. Crebassa. Supt., Jos. Maur.

THREE RIVERS, *St. Maurice Co.* (Pop., 9,296; est., do.) At junction of St. Maurice and St. Lawrence rivers. Settled about 1620; incorp. city in '57.

History.—Built by city in 75. Const. Engrs., P. N. Robichon and Henry Lor.

Water Supply.—St. Lawrence river, by direct pumping from settling reservoir.

Filter.—Consists of 9 ft. of broken stone and coarse sand, through which water passes to reservoir.

Settling Reservoir.—In wharf. Water passes from this to pump-well through 120 ft. of 8-in. w. i. pipe.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; dup., of 12 x 24-in. steam, and 7-in. water cylinder, from Beauchemin & Sons, Sorel.

Distribution.—(In '87.) *Mains*, c. i., 15 miles; made in Scotland. *Services*, lead. *Taps*, 1,400. *Meters*, 3. *Hydrants*, 57.

Consumption (in '87), 250,000 galls. *Pressure:* Ordinary, 85 lbs. Fire, 130 lbs.

Financial.—(In '87.) Cost, $130,000. Debt, $115,000. Int., 6%. Ann. op. exp., $5,000. Ann. rev.: consumers, $14,000; city, $1,000.

Management.—(In '88.) Supt., O. Z. Hamel.

NOTE.—No report for '89 could be obtained.

VALLEYFIELD, *Beauharnois Co.* (Pop., 4,000; est., 5,300.) On St. Lawrence river. Manufacturing town with good water-power. Incorp. Has sewers and electric lights.

History.—Built in '86, now owned by city, having been bought in '87 from Valleyfield Water-Works Co. Engr., G. E. Vanier, Montreal. Contrs., Octave Cossette.

Water Supply.—St. Lawrence river, pumping direct.

Pumping Machinery.—Dy. cap., 1,200,000 galls.; two Blake dup. water-power. *Water-wheels:* two 33-in. turbines; from J. C. Wilson, Picton.

Distribution.—*Mains*, 10 to 4-in. c. i., 6 miles; from McFarlane, Strong & Co., Glasgow, Scotland. *Services*, lead. *Taps*, 660. *Meters*, 1. *Hydrants*, Chapman, 46. *Valves*, McFarlane, Strong & Co.

Consumption, not given. *Pressure:* Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—Cost (Jan. 1, '89), $69,000. Bonded debt, $69,000. Int., 6%. Sinking fund, 2%. Ann. op. exp., $1,000. Ann. rev.: consumers, $6,000. Original cost, $55,000.

Management.—Secy. and Treas. of Corporation, R. S. Joron. Supt., Emmanuel May.

Water-Works Projected with Fair Prospects of Construction.

SAINT LAMBERT, *Chambly Co.* (Pop., 500; est., 750.) About 3 miles from Longueuil.

Proposed Works.—Under consideration early in '90. Address Chas. Gowan.

Water-Works Projects Reported in '89 and '90, but now Indefinite.

Boucherville, Chambly Co. *Chicoutimi*, Chicoutimi Co. *Cote St. Paul (near Montreal)*. *Lachine*, Montreal Co.; see MANUAL for '88, p. 549. *Ripon*, Ottawa Co.

ONTARIO.

Water-Works Completed or in Process of Construction.

AYLMER, *Ottawa Co.* (Pop., 1,762; est., 2,500.) On Catfish creek. Has manufactories. Has electric lights.

History.—Built for fire protection and lawn sprinkling in '84 by town. Engr., Alex. Milne, Aylmer. Labor done by day. **Water Supply.**—Catfish creek, by direct pumping. **Pumping Machinery.**—Dy. cap., 700,000 galls.: Worthington. **Distribution.**—*Mains*, 8 to 4-in. c. i., 3.8 miles; from Alex. Gartshore, Hamilton. *Services*, w. i. *Taps*, 63. *Hydrants*, Perkins, 24. *Valves*, Toronto. *Pressure:* Ordinary, 60 lbs. Fire, 100 lbs. **Financial.**—(Approximately.) Cost, $14,000. Debt, $14,000. Int., 5%. Ann. op. exp., $600. Ann. rev.: consumers, $400; city, none. **Management.**—Engr., Alex. Milne.

BELLEVILLE, *Hastings Co.* (Pop., 9,516; est., 11,000.) On Bay of Quinte at mouth of Moira river. Has manufactories. Incorp. Has electric lights.

History.—Built in '87 by Moffett, Hodgkins & Clarke, Syracuse, N. Y.

Wat r Supply.—Lake, filtered, pumping to tank.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; Worthington.

Tank.—No data.

Distribution.—*Mains*, c. i., 15.3 miles. *Services*, galv. i. *Taps*, 268. *Meters*, 23. *Hydrants*, 168.

Consumption, 305,000 galls. *Pressure:* Ordinary, 70 lbs. Fire, 150 lbs.

Financial.—Cost, $200,000. Debt, $100,000. Int., 6%. Ann. op. exp., withheld, est., $4,000. Ann. rev.: consumers, withheld, est., $8,000; city, $7,000. Hydrant rental, about $40.

Management.—Prest., J. V. Clarke, Syracuse, N. Y. Supt., Geo. A. Pope.

BERLIN, *Waterloo Co.* (Pop., 4,800; est., 7,500.) Engaged in various manufactories. Has electric lights.

History.—Built in '88 by Moffett, Hodgkins & Clarke, Syracuse, N. Y.

Water Supply.—Springs, pumping to stand-pipe from brick pump-well; connection can also be made with lake in case of emergency.

Pumping Machinery.—Dy. cap., 1,250,000 galls.; two Worthington. *Boilers:* two, steel tubular, 14x5 ft.

Stand-Pipe.—Cap., 156,000 galls.; 16x104 ft.; on elevation of 94 ft.

Distribution.—*Mains*, c. i., 8.69 miles. *Taps*, 189. *Meters*, 16. *Hydrants*, 79.

Consumption, 250,000 galls. *Pressure*, not given.

Financial.—Cost, $100,000. Debt, $73,000. Int., 6%. Ann. op. exp., $3,000. Ann. rev.: consumers, $6,000; city, $3,200. Hydrant rental, $50.

Management.—Prest., C. T. Moffett. Supt., H. J. Bowman.

BRAMPTON, *Peel Co.* (Pop., 1,920; est., 2,500.) On Etobicoke river, on slightly undulating ground. Has some manufactories. Settled in '37; incorp. town in '73. Has electric lights.

History.—Built in '81-2 by town. Des. Engr., Louis H. Knapp, or —— Tracey, London. Const. Engr., Charles G. Wheelock, Orangeville. Contrs., Stephens, Turner & Burns, London.

Water Supply.—Snell's lake, by gravity. Lake has area of about 40 acres, drainage area of 700 acres, is 4½ miles from and 120 ft. above town.

Filter.—Water passes from lake to conduit through timber crib filled with gravel.

Supply Conduit.—Of 12-in. c. i., about 4½ miles long.

Distribution.—(Approximately.) *Mains*, c. i., 4 miles; from Alex. Gartshore, Hamilton. *Services*, lead. *Meters*, none. *Hydrants*, 60.

Consumption, about 300,000 galls. *Pressure*, 50 lbs.

Financial.—(Approximately.) Cost, $65,000. Bonded debt, $65,000. Int., 5%. Ann. op. exp., $200. Ann. rev.: consumers, $3,600, of which $1,500 is from railways.

Management.—Town Council. Mgr., Richard Blain.

BRANTFORD, *Brant Co.* (Pop., 9,626; est., 13,000.) On Grand river. Has manufactories. Settled about '30; incorp. city in '76. Has electric lights.

History.—Built in '69-70 by Brantford Water-Works Co., chiefly for fire protection. Des. Engr., C. H. Wilson. Unofficially reported that works were greatly improved in '89. **Water Supply.**—Spring creek, by direct pumping and pumping to tank. Point of supply is about one mile from town, and water is partially filtered through gravel, and is not potable. **New Supply.**—Unofficially reported in '89. **Pumping Machinery.**—Dy cap., 4,000,000 gals., 2,000,000 Worthington dup., 2,000,000 Gaskill horizontal. **Tank.**—Cap., 29,000 galls.; brick, 15 x 26 ft., x ft. deep. **Distribution.**—(In '87.) *Mains*, c. i., 7½ miles; chiefly from Alex. Gartshore, Hamilton. *Services*, w. i. *Taps*, 103. *Meters*, 12. *Hydrants*, 26. *Consumption* (in '87), 175,342 galls. *Pressure:* Ordinary, 63 lbs. Fire, 75 lbs. **Financial.**—(In '87.) Cost, 60,961. Cap. stock, $61,000. No debt. Ann. op. exp., $2,300. Ann. rev.: consumers, $4,800; city, $3,658, or 6% on total outlay for Co.'s plant. **Management.**—Prest., Ignatius Cockshutt. Secy. and Supt., T. M. Shenston.

NOTE.—No report could be obtained in '89.

BROCKVILLE, *Leeds Co.* (Pop., 7,638; est., 9,000.) On St. Lawrence river. Has manufactories. Has electric lights.

History.—Built in '81-4 by Brockville Water Co. Des. Engr., H. F. Gaskill, Lockport, N. Y. Supervising Engr., Willis Chipman, Toronto. Contrs., J. B. A. Beique began, and Tourville & Co. finished, works.

Water Supply.—St. Lawrence river, pumping direct.

Intake.—A crib, 25x30 ft., x 42½ ft. deep, is located 425 ft. from low water mark, and from it a 16-in. suction pipe, with flexible joints, extends to pump-well 8 ft. in diam., 12 ft. deep. At end of suction pipe there is a screen of 1-in. iron bars and ¼-in. galvanized wire gauze.

Pumping Machinery.—Dy. cap., 3,000,000 galls; two Gaskill horizontal, comp., cond. of 12-in. bore and 18-in. stroke.

Distribution.—*Mains*, c. i., 9 miles; from Alex. Gartshore, Hamilton. *Services*, lead. *Taps*, 455. *Meters*, 3. *Hydrants*, Chapman, 85. *Valves*, Chapman.

Consumption, 900,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 75 to 90 lbs.

Financial.—Cost, $200,000. Cap. stock, $200,000. Bonded debt (in '88), $40,000; report for '89 says, debt, "none." Int., 6%. Ann. op. exp., $5,000. Ann. rev.: consumers, $15,000; city, $4,000. Hydrant rental, about $50.

Management.—Prest., W. H. Cole. Mgr., Secy. and Treas., B. F. Steben.

CAMPBELLFORD, *Northumberland Co.* (Pop., est., 2,500.) On Trent river Has good water-power and manufactories. Incorp. village. No sewers. Has electric lights.

History.—Built in '89-90 by village; Jan. 23, works were completed but had not been accepted. Engr., Jno. Galt, Toronto. Contrs., Miles Hunting & Co., Hamilton.

Water Supply.—Trent river, pumping direct.

Pumping Machinery.—Dy cap., not given; Worthington.

Financial.—Cost, $19,000. Debt, about $19,500. Int., 5%.

Management.—Reports by W. B. Archer and Jno. Kennedy; dates, Jan. 13 and Feb. 8, '90.

CHATHAM, *Kent Co.* (Pop., 8,500; est., 11,000.) On Thames river. Engaged in manufacturing and boat-building. Incorp. town. No sewers. Has electric lights.

History.—Built in '89-90 by Chatham Water-Works Co.; expected to have in operation Sept. 1, '90. Engrs. and Contrs., Hinds & Bond, Watertown, N. Y., with Chas. A. McComb in charge of construction.

Water Supply.—Driven wells, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 3,000,000 galls.

Stand-Pipe.—Cap., 246,000 galls.; 20 x 105 ft.; iron; from Porter Mfg. Co., Syracuse, N. Y.

Distribution.—*Mains*, c. i., 13 miles; from Canada Pipe Foundry, Hamilton, Ont. *Services*, w. i., lead. *Hydrants*, Holyoke, 163. *Valves*, Eddy.

Pressure: Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—Cost, est., $200,000. Cap. stock, authorized, $250,000. Debt and int., not given. Hydrant rental, $38.

Management.—Prest., F. A. Hinds. Sec. and Treas., Edw. A. Bond. Both of Watertown, N. Y. Report, Mar. 14, '90.

COBOURG, *Northumberland Co.* (Pop., 4,957; est., 5,000.) Incorp. No sewers. Has electric lights.

History.--Built in '88-9 by Cobourg Water-Works Co.; controlled by Moffett, Hodgkins & Clarke, Syracuse, N. Y., Engrs. and Contrs.

Water Supply.—Lake Ontario, pumping through canal to stand-pipe and direct.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; Worthington.

Stand-Pipe.--Cap., 157,000 galls.; 16 x 104 ft.

Distribution.--*Mains*, 12 to 4-in. c. i., 8 miles. *Taps*, 40. *Meters*, not given. *Hydrants*, 70.

Consumption and *Pressure*, not given.

Financial.--Cost, $100,000. Debt, $70,000. Int., 6%. Ann. op. exp., $1,500. Ann. rev.: consumers, $5,000; city, $3,000.

Management.--Prest., J. F. Moffett, Syracuse, N. Y. Supt., A. J. Hewson.

COLLINGWOOD, *Simcoe Co.* (Pop., 4,448; est., 5,000.) On Georgian bay. Engaged in manufacturing and trade. Incorp. town. No sewers. Electric lights under construction.

History.—Built in '89-'90 by town; put in operation Feb. 10, '90. Des. Engr., Jno. Galt, Toronto. Const. Engr., Arthur B. Stephen. Contr., Jas. Lindsay, Collingwood. Electric lights to be operated in connection with works.

Water Supply.—Lake Huron, pumping direct. No filtration.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Worthington comp., dup., from Kerr Bros., Walkerville. *Boilers:* from Jno. Doty Co., Toronto.

Distribution.—*Mains*, 12 to 4-in. c. i., 6½ miles; from A. Gartshore, Hamilton. *Hydrants*, Toronto pattern, 53. *Valves*, from Kerr Bros., Walkerville.

Financial.—Cost, $65,000. Bonds authorized and issued, $65,000. Int., 5%. Bonds sold at $105.54.

Management.—Town Clerk, Jno. Hogg. Supt., Thos. Bassett. Report, Feb. 10, '90.

CORNWALL, *Stormont Co.* (Pop., 4,468; est., 5,000.) On St. Lawrence river. Manufactures cotton, woollen, and other goods.

History.—Built in '86 by Cornwall Water Co., under 50-years franchise; controlled by Moffett, Hodgkins & Clarke, Syracuse, N. Y. Const. Engr., O. W. Weed. Consult. Engr., Willis Chipman, Toronto.

Water Supply.—St. Lawrence river, pumping to stand-pipe.

Intake.--Originally 16-in. suction pipe extended from pumps to caisson on shore; in '89 this was replaced by two 10-in. suction pipes, one for each pump. At same time new pipe was laid from caisson into river, to 3 ft. of water.

Pumping Machinery.—Dy. cap., 2,500,000 galls.; Worthington.

Canal Crossings.—Originally one 12-in. main. In '89 it became necessary to lower and otherwise change this, owing to changes made in the canal, so an additional 12-in. main was laid at same time. Old main was supported during excavation by U bolts with 8-in. thread, passing through ⅝x4x18-in. washers, or bars, resting on 6x6-in. timbers. Canal about 130 ft. wide at this point, and when pipe was laid, bottom of trench was about 9 ft. below surface of water. Trench dug and work done in sections by means of timber coffer-dam, which was moved crosswise the canal, as needed. At one shore end two concrete cut-off walls surround pipe beneath one of the banks: one 7 ft. thick to support wall of canal, other 3 ft. thick inland from first. A new connection was made between pumps and these mains. Engr. for this work, and for changes noted under intake, F. S. Pecke, Watertown, N. Y.

Stand-Pipe.—Cap., 230,000 galls.; of iron; from Sharon (Pa.) Boiler Works.

Distribution.—*Mains*, c. i., 9 miles. *Services*, galv. i. Pipe and specials from Alex. Gartshore, Hamilton. *Taps*, 197. *Meters*, 5. *Hydrants*, from Chas. Smith & Co., Toronto, 62. *Valves*, Ludlow.

Consumption, 260,000 galls. *Pressure:* Ordinary, 63 lbs. Fire, 150 lbs.

Financial.—Cost, $125,000. Debt, $80,000. Int., 6%. Ann. op. exp., $2,500. Ann. rev.: consumers, $5,000; city, $3,600. Hydrant rental, $58.

Management.- Prest., J. V. Clarke. Secy., H. C. Hodgkins. Both of Syracuse N. Y. Supt., Jas. Strickland

DUNDAS, *Wentworth Co.* (Pop., 4,000; est., 3,000.) On Burlington bay, Lake Ontario. Engaged in manufacturing.

History.—Built in '83 by town. Engr., J. B. E. Hugh Fairgrieve, Hamilton

Water Supply.—Springs, by gravity from receiving reservoir. Springs are on hills 500 ft. high, back of town.

Reservoir.—Cap., 1,250,000 galls.; built by town.

Distribution.—(In '87.) *Mains*, 12 to 6-in., material not given, 6 miles; from Stevens, Turner & Burns, London. *Taps* and *Meters*, not given. *Hydrants*, about 40.

Consumption, not given. *Pressure*, 75 to 110 lbs.

Financial.—(In 87.) Cost, about $40,000. The sum of $100 a year is paid a "care taker." Debt, int. and rev., not given.

Management.—Chn., A. Bertram. Report by J. E. W. McFarlane.

NOTE.—No report for '89 could be obtained.

GANANOQUE, *Leeds Co.* (Pop., 2,856; est., 3,500.) Has electric lights.

General Description.—Built by town for fire protection. A Giant water-wheel drives a rotary pump, water being furnished free by the Gananoque Water-Power Co. at one of their dams. *Mains*, 3-in. c. i., ½ mile. *Hydrants*, made by C. E. Abbott, 14. *Pressure*, 90 lbs. Cost, $4,000. Ann. op. exp., about $100. Report by C. R. Cotton, Supt. of Power Co.

GODERICH, *Huron Co.* (Pop., 4,500; est., 5,000.) On shore of and 150 ft. above Lake Huron, on a level plateau. Incorp. No sewers. Has electric lights.

History.—Built in '88 by city. Engr., Willis Chipman, Toronto. Contr., E. Sherman, Goderich.

Water Supply.—Artesian wells, and Lake Huron in case of emergency, pumping direct. There are 4 wells, each 8 ins. in diam., 250 ft. deep. Water from wells rises 14 ft. above surface, has temperature of 49° Fahr., and is very pure.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; Gordon comp., dup. *Boilers:* from Chrystal & Black, Goderich.

Distribution.—*Mains*, c. i., 8 miles. Pipe and specials from A. Gartshore, Hamilton. Trenching and pipe-laying done by Harding & Leathorn, London. *Taps* and *Meters*, not given. *Hydrants*, from J. Currie & Co., London, 48. *Valves*, from J. Currie & Co.

Consumption, 200,000 galls. *Pressure:* Ordinary, 125 lbs. Fire, 175 lbs.

Financial.—Cost, $50,000. Debt and int., not given. Sinking fund, $812.

Management.—City Council. Report by Wm. Mitchell.

GUELPH, *Wellington Co.* (Pop., 10,000; est., 10,570.) On Speed river, on undulating ground rising 130 ft. above river. Has various manufactories. Settled in '27; incorp. city in '79. No sewers. Has electric lights.

History.—Built in '79-80 by city. Des. Engrs., Thos. Inglis and F. W. Cooper. Const. Engr., Thos. Inglis.

Water Supply.—Springs and surface water, with river connection for emergency, by direct pumping from reservoirs.

Reservoirs.—A T-shaped basin, excavated through gravel and clay to 10 ft. below river surface receives water from springs and from infiltration. A 30-in. brick conduit leads from this to Speed river, and the suction pipe is so arranged that water can be drawn from either basin or river. About 250 ft. from this basin is a second, plan having been to have water filter through gravel between the two, pump-well being at the second.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; two pairs, 7¼ x 22 ins., made by Blaikie & McKay, Sarnia; one pair is kept as reserve in case of fire. First pumps had 14-in. water, and 7-in. steam cylinders of 22-in. stroke, and were made by Inglis & Hunter, Guelph. A 1,500,000-gall. Walker is also reported.

Distribution.—*Mains*, c. i., 16 miles. *Services*, lead. Pipe and specials from St. Lawrence Foundry, Toronto; trenching and pipe-laying done by Jno. Wanless & Jno. Heuer. *Taps*, 520. *Meters*, 4. *Hydrants*, Mathews double, 104.

Consumption, 500,000 galls. *Pressure:* Ordinary, 85 lbs. Fire, 120 lbs.

Financial.—Cost, $125,000. Debt, $80,000. Int., 6%. Ann. op. exp., $5,000. Ann. rev.: consumers, $3,000; city, $2,100. Hydrant rental, $20.

Management.—Supt., Richard Mitchell.

HAMILTON, *Wentworth Co.* (Pop., 35,965; est., 45,000.) At head of Hamilton, or Burlington bay, Lake Ontario, on sloping ground extending from bay to foot of hill, 1¼ miles. Business part of town is 70 ft. above lake. Settled in 1779, but as late as '30 had but 653 inhabitants. Incorp. city. Has sewers and electric lights.

History.—Built in '56-9 by city. Des. Engr., Thos. C. Keefer, Ottawa. Contr., for masonry and foundations, Isaiah Beer.

Water Supply.—Lake Ontario, pumping direct and to reservoir from filter basin on sand bar between bay and main lake. Reservoir receives and stores surplus water pumped.

Water of bay is unfit for use, as city sewage and street drainage discharge into it, and also drainage from large vegetable deposits in the Des Jardin Marsh. Soil at this point is red clay, and lake water is reddened by wash of banks, and at times has fine sand in suspension.

Filter Basin.—Dredged in sand and gravel beach, and originally having depth of 6 ft. below lake surface, and area of 1¼ acres; in '72 it was enlarged and deepened. In Oct., '79, continuous pumping for a week at rate of 2,500,000 galls. a day lowered the water 2.6 ft. below lake level.

Pumping Machinery.—Dy. cap., 13,000,000 Imp., or about 15,600,000 U. S. galls.; one; old machinery consists of two Simpson comp., cond. vertical beam and fly-wheel engines, with bucket and plunger pumps, having vacuum vessel on the suction, and large e. i. chamber on force mains. The high-pressure cylinders are 24-in. and of 72-in. stroke; the low-pressure, are 42-ins. in diam. and of 96-in. stroke. These pumps were made in about '59 by Alex. Gartshore, Hamilton, while in '87-8 Osborne, Kelly & Co., Hamilton, built horizontal comp., cond. pumps. In '81 a small pump was also in use. In '89, a 1,500,000 Worthington was reported.

Force Main.—Is 18 ins. in diam., 6 miles long, and leads directly to distributing systems, with branch to reservoir through which surplus water passes.

Reservoir.—Cap., 11,000,000 Imp., or 13,190,000 U. S. galls.; midway between pumps and city, on mountain side, 185 ft. above lake.

Tank.—Used in '81 for limited high service. Size not given.

Distribution.—*Mains*, e. i., 75 miles; from Alex. Gartshore, Hamilton. Trenching and pipe-laying, in '57-9, done by W. Kendrie, and now done by day. *Services*, lead. *Taps*, 12,000. *Meters*, 3. *Hydrants*, Ludlow, 520. *Valves*, Ludlow.

Consumption, 4,000,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 75 lbs.

Financial.—Cost, $1,100,000. Bonded debt (in '87), $900,000. Int., 6%. Ann. op. exp. (in '87), $26,000. Ann. rev.: consumers, $40,000; city none.

To '60, works cost $650,000. To Dec. 31, '80, total expenditures has been $945,353, and total receipts, $397,793. In '80, op. exp. were $27,629, and receipts, $99,729.

Management.—Prest., Jno. Carruthers. Mgr. and Supt., Wm. Haskins, the City Eng. Secy., W. Monk. Pumpg. Engr., Jas. McFarlane.

INGERSOLL, *Oxford Co.* (Pop., 4,500; est., 5,000.) On Thames river. Has various manufactories. Incorp. town. No sewers. Has electric lights.

History.—Built in '90 by Ingersoll Water-Works Co.; controlled by Moffett, Hodgkins & Clarke, Syracuse, N. Y., the Engrs. and Contrs. Construction began in May, hoped to finish in Oct.

Water Supply.—Choate's pond and springs, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; water-power and comp., dup., steam.

Distribution.—*Mains*, c. i., 7 miles. *Hydrants*, 65.

Management.—Prest., J. F. Moffett. Secy., H. C. Hodgkins. Both of Syracuse, N. Y. Report, May 29, '89.

IROQUOIS, *Dundas Co.* (Pop., 1,500.) Incorp. Partially sewered. Has electric lights.

History.—Built in '85-6 by R. H. Buchanan & Gordon Serviss. Engr., Wm. Perry. Labor done by owners.

Water Supply.—St. Lawrence river, by direct pumping.

Pumping Machinery.—Not described.

Distribution.—*Mains*, c. i., 1¼ miles; imported from Scotland. *Services*, lead. *Taps* (in '86), 35. *Meters*, none. *Hydrants*, 15.

Consumption (in '87), about 50,000 galls. *Pressure*, Ordinary, 45 lbs. Fire, 75 lbs.

Financial.—Cost, $18,000. Cap. stock, $18,000. No debt. Ann. op. exp., $450. Ann. rev.: consumers, $100; city (in '86), $1,550; G. T. Ry., $900.

Management.—Prest., R. H. Buchanan. Supt., Gordon Serviss.

KINGSTON, *Frontenac Co.* (Pop., 14,093; est., 16,000.) At head of St. Lawrence river, on Lake Ontario. Has extensive manufactories. Incorp. Has sewers and electric lights.

History.—Now owned by city. Built in '51 by Co. and sold in '87 to city. In '88-90 extensions were made. Engr. for new work, T. O. Boiyer, City Engr. and Mgr.

Water Supply.—Lake Ontario, pumping to reservoir and stand-pipe.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; make not given.

Reservoir.—Not described.

Stand-Pipe.—Cap., 650,000 galls.; 40 x 80 ft.; of steel; built in '89; cost, $15,000.

Distribution.—*Mains*, c. i., 14 miles; from Alex. Gartshore, Hamilton. *Services*, lead. *Taps* (in '87), 1,200. *Meters*, 32. *Hydrants*, 100.

Consumption, 1,000,000 galls. *Pressure*, 20 to 40 lbs.

Financial.—Cost to city to Jan. 1, '89, $215,000. Int., 4½. Cost to Co. to '86, $150,000. Price paid by city, $130,000. Bonded debt, $250,000. Sinking fund, $2,400. Ann. op. exp., $6,600. Ann. rev.: consumers, $22,500; city, $1,500.

Management.—Chn., C. F. Gildersleeve. Secy., F. Smith. Supt., T. Hewett.

LINDSAY, *Victoria Co.* (Pop., 5,081; est., 6,500.) On Scugog river. Has electric lights.

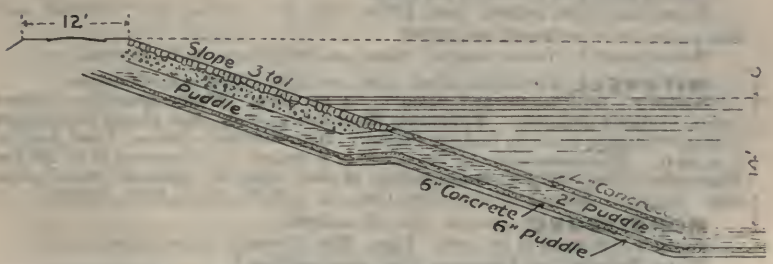
History.—Built in '71 by town, for fire protection. **Water Supply.**—Scugog river, by direct pumping. **Pumping Machinery.**—Dy. cap., not given; one No. 4 Worthington steam; two Holly driven by two 52-in. turbines working under 6½ to 8 ft. head. Holly pumps were made by Waterous, of Brantford. **Distribution.**—*Mains*, 8-in. c. i., about 1 mile. *Hydrants*, 17, made by Waterous Co. and H. Piper, Toronto. *Pressure*, 110 lbs. **Financial.**—Cost, about $15,000. Bonded debt, $10,000. Int., 6%. Ann. op. exp., about $1,600. No rev. **Management.**—Chf. Engr., Jno. Makins. Report by Dr. Burrows.

LISTOWELL, *Perth Co.* (Pop., 2,684; est., 3,000.)

History.—Built for fire protection in '84 by town, Hess Bros. owning and operating pumping machinery, in connection with their factory, for $500 a year. **Water Supply.**—Stream, by direct pumping. **Pumping Machinery.**—Dy. cap., 1,500,000 galls.; two Northey, one of 700,000 galls. cap., with 14-in. steam, and 8-in. water cylinders; one of 800,000 galls., with 16-in. steam, and 8-in water cylinders. Both owned and operated by Hess Bros., in connection with furniture factory. **Distribution.**—*Mains*, 6 and 4-in., ¼ mile. *Hydrants*, made by N. L. Piper, Toronto, 6. **Financial.**—Cost, to city, $6,000. No. debt. Ann. op. exp., $500. No. rev. **Management.**—Chf. Fire Dept., R. I. Kempfe. Town Clerk, Jno. W. Burgess.

LONDON, *Middlesex Co.* (Pop., 19,763; est., 35,000.) At junction of North and South branches of Thames river. Settled in '26. Incorp. in '55. Partially sewered. Has electric lights.

History.—Built in '78 by city, when pop. was about 20,000. Des. Engrs., Robinson & Tracy. Const. Engr., Thos. H. Tracy, present Supt. Consult. Engr., Thos. C. Keefer, Ottawa, Ont. Principal Contrs., Stevens & Burns, London.



Cross-Section, Reservoir Embankment, London, Ont.

Water Supply.—Springs, about 4 miles from city, pumping to reservoir and direct.

Thames River Dam.—To give head to drive pumps; 350 ft. long, including spillway, 10½ ft. high, 60 ft. wide at bottom. Formed by piles about 6 ft. apart, connected by timbers, drift-bolted, spaces filled with stone. Apron of stone-filled cribs. The whole planked. Inner slope heavily filled against with earth or stone. Forebay admits water to pump-house just below dam. *Spillway:* at extreme north end, opposite forebay, 20 ft. wide. Built in '78. Contr., J. Crouse. Cost, $17,000.

Pumping Machinery.—Dy. cap., 5,000,000 galls.; two Worthington water-power, driven by two 72-in. Risden turbines, under 12-ft. head, and one horizontal comp., cond., steam, made by Osborne, Kelly & Co., Hamilton.

Reservoir.—Cap., 7,000,000 galls.; 200 ft. sq., formed by embankment across one side of natural depression See accompanying section. Built in '78. Engrs. and Contrs., see History. Cost, $28,000.

Supply Main.—Principal one is of 18-in. c. i., tested to 500 lbs. per sq. in. It crosses over river twice, and under it once.

Distribution.—*Mains*, c. i., 51 miles; from Contrs. *Services*, lead. *Taps*, 4,666. *Meters*, (in '87), 25. *Hydrants*, 268 public, 30 private. Valves and hydrants from Contrs., hydrants being similar to Mathews, and the large valves to Eddy.

Consumption, 2,000,000 galls. *Pressure*, 80 lbs.

Financial.—Cost $519,546. Debt, $464,628: $365,035 at 6, $99,593 at 5%. Sinking fund, $75,000. Ann. op. exp., $15.000. Ann. rev.: consumers, $40,767; city, $9.263. Hydrant rental, $25.

Management.—Secy., J. O. Elwood. Engr., Thos. H. Tracy.

LUCKNOW, *Huron Co.* (Pop., 718; est., 1,500.) Has manufactories.

General Description.—Built in '89-90 by town for fire protection. Engrs. and Contrs., McQuillan & Co., Toronto. Supply, millpond within town limits, pumping to tank. Cost, about $11,000. Debt, $11,000. Chn., Jas. B. Reeve. Report by H. Morrison; date, about Oct. 10, '89.

MERRITTON, (Pop., est., 2,000.) Near Grand river and New Welland canal.

History.—Built in '88 by town. Des. Engr., Thos. Monro. Const. Engr., S. H. Reynolds. Both of St. Catherines.

Water Supply.—Lake Erie, by gravity to reservoir.

Reservoir.—Cap., 4,000,000 galls; area, 20 acres.

Distribution.—*Mains*, 16 to 4-in. c. i., 6 miles; from Alex. Gartshore, Hamilton *Taps*, 100. *Hydrants*, department design, 38. *Valves*, Eddy.

Consumption, not given. *Pressure*, 105 lbs.

Financial.—Cost, $70,000. Debt, $70,000. Int., 5%. Ann. op. exp., $450. Ann. rev.: consumers, withheld, est., $3,000.

Management.—Supt., H. Clark.

MILTON, *Halton Co.* (Pop., est., 1,400.) Incorp. Partially sewered. No electric lights.

History.—Built in '87-8 by town. Engr., Jas. A. Bell, St. Thomas. Contrs., McQuillan & Co., Toronto.

Water Supply.—Springs, by gravity to reservoir. Springs have dy. flow of 150,000 galls.

Reservoir.—Cap., 150,000 galls.

Distribution.—*Mains*, 8-in., 4 miles. *Taps* and *Meters*, not given. *Hydrants*, 14.

Consumption and *Pressure*, not given.

Financial.—Cost, $18,400. Debt, $20,000. Int., 5%. Ann. op. exp., withheld, est. $400. Ann. rev.: withheld, est., $2,000.

Management.—Town Council. Mayor, S. Dill. Clerk, M. E. Mitchell.

MITCHELL, *Perth Co.* (Pop., 2,500; est., 2,300.) Has manufactories.

History.—Built for fire protection in '74 by town. **Water Supply.**—Surface water, by direct pumping. **Pumping Machinery.**—Cap., not given; two pumps of 16-in. cylinders, made by Inglis & Hunter. **Distribution.**—*Mains*, 6 and 4-in. c. i., 6,500 ft. *Hydrants*, made by Thompson & Williams, 10. *Pressure*, 80 to 100 lbs. **Financial.**—Cost, $15,000. Bonded debt, $15,000. Int., 6%. Ann. op. exp., about $900. No. rev. **Management.**—Chn. Com., R. A. Bell. Clerk, Robt. Christie.

MORRISBURG, *Dundas Co.* (Pop., 2,000.)

History.—Built in '87 by town. Engr., Wm. Kennedy, Owen Sound.

Water Supply.—St. Lawrence river, pumping direct.

Pumping Machinery.—*For domestic supply:* dy. cap., 504,000 galls.; one single-acting plunger water-power pump with 3 pistons, each 7½ ins. in diam., 20-in. stroke, working against 90 lbs. pressure in air vessels. *Water-wheel:* 40-in.

For fire protection: cap., 1,440,000 galls.; one Silsby rotary water-power pump, working against 90 lbs. pressure in air vessels. *Water-wheel:* 61 ins. in diam. Power is taken from St. Lawrence canal, which gives 8 to 10 ft. head. Water-wheels can be shifted to operate either pump, or coupled together and run one or both. A dup. steam Blake, 14-in. cylinders, with steel horizontal tubular boiler, 54 ins. in diam., 12 ft. long, has been provided for use when repairs are being made to canal.

Distribution.—(In '87.) *Mains*, material not given, 3 miles. Pipe and specials from Bellhouse, Dillon & Co., Montreal. Trenching and pipe-laying done by M. Ryan, Toronto. *Hydrants*, 22.

Pressure: Ordinary, 40 lbs. Fire, 120 lbs.

Financial.—(In '87.) Cost, $26,000. Debt, $26,000. Int., 5%. Ann. op. exp., about $400. Ann. rev.: consumers, not given; city, none.

Management.—(In '88.) Town Council. Report by Wm. McKenzie.

NOTE.—No report for '89 could be obtained.

NAPANEE, *Lenox Co.* (Pop., 3,681; est., 4,800.) On Napanee river. Incorp. town. No sewers. Has electric lights.

History.—Completed about June 1, '90, by Napanee Water-Works Co Begun in '87-8 by J. P. Northey, Toronto, under franchise granted to him. Mr. Northey let contracts; one pump was in and some pipe laid, when work was stopped, owing to a bank failure. In '89 franchise was secured by M. D. Hanover, now deceased, and F. A. Hinds, Watertown, N. Y., and above Co organized. Engrs. and Contrs., Hinds & Bond, Watertown, N. Y.

Water Supply.—Napanee, river, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; Worthington pattern, from Northey Co., Toronto.

Stand-Pipe.—Cap., 150,000 galls.; 16x100 ft.; from Dominion Bridge Co., Ltd., Toronto.

Distribution.—*Mains*, 12 to 6-in. c. i., 3 miles. *Services*, w. i. Pipe and specials from St. Lawrence Foundry, Toronto, and Canada Pipe Foundry, Hamilton. *Hydrants*, from Toronto Engine Works, also Holyoke, 33. *Valves*, Eddy.

Pressure: Ordinary, 45 lbs. Fire, 125 lbs.

Financial.—Cost, est., $60,000. Capital stock, authorized and paid up, $60,000. Hydrant rental, $50.

Management.—Prest., Frank A. Hinds. Secy., Edw. A. Bond. Both of Watertown, N. Y. Treas., Geo. B. Phelps. Address Hinds & Bond, Watertown, N. Y.

NEWMARKET, *York Co.* (Pop , 2,006; est., 2,500.) Incorp. town. No sewers. Has electric lights.

History.—Built in '86 by town. No Engr. Contrs., McQuillan & Co., Toronto.

Water Supply.—Artesian well, pumping to reservoir.

Pumping Machinery.—Dy. cap., 1,440,000 galls.; Worthington type, made by Inglis & Hunter, Toronto.

Reservoir.—Cap., 1,000,000 galls. Contr., Jno. Savage.

Distribution.—*Mains*, 8 to 4-in. c. i., 3 miles. *Services*, galv. i. *Taps*, 90. *Meters*, none. *Hydrants*, Toronto, 22. *Valves*, Chapman.

Consumption, 25,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 140 lbs.

Financial.—Cost, $18,000. Bonded debt, $17,000. Int., 4¾%. Ann. op exp., $450. Ann. rev.: consumers, $5,800.

Management.—Chn., H. S. Cane. Supt., S. Warren. Report, Aug. 2, '89.

NIAGARA FALLS, *Welland Co.* (Pop., 3,000; est., 3,800.) On Niagara river, below the Falls. Settled in '52; incorp. town in '57.

History.—Now owned by town, having been bought in '84 from Niagara Water-Works Co. for $17,000. Works were built in '56 by Saml. Zimmermann, and Co. organized later. In '89 town voted $77,500 of 5% bonds for extension of works. See Note below.

Water Supply.—Niagara river, by direct pumping, surplus going to reservoir.

Pumping Machinery.—Dy. cap., about 500,000 galls.; double-acting piston pump, driven by an 8-ft. over-shot wat r-wheel.

Force Main.—Of 6 in. c. i., 2 miles long.

Reservoirs.—Cap., 1,530,000 galls.; two of 1,500,000 galls. and 30,000 galls. cap., respectively. First is lined with brick, and has broken twice. In '82 there was a stand-pipe at end of force-main in large reservoir.

Distribution.—*Mains*, c. i., about 11 miles. *Services*, w. i. *Taps*, 346. *Meters*, none. *Hydrants*, 4.

Consumption, about 500,000 galls. *Pressure*, at pump, 30 lbs.

Financial.—Cost, price paid by the city, in '84, $17,000. The est. cost or value, is $30,000. Bonded debt, $13,000. Int., 5%. Ann. op. exp., $2,270. Ann. rev.: consumers, $3,219.

Management.—Town Clerk, Jno. Robinson. Supt., Edw. C. Carter.

NOTE.—A wooden conduit, 6 x 8 ft., about 600 ft. long will conduct water for power to the wheel-house. From upper end of conduit an open cut, 12 ft. wide, 11 ft. deep, will extend into the river about 150 ft. toward northern end of Cedar island. A 14-in. pipe will convey water to the pumps, being laid alongside the conduit, and extending through and a little beyond open cut. Above is subject to corrections and additions.

ORANGEVILLE, *Wellington Co.* (Pop., est., 4,000.) Near Credit river. **History.**—Built for fire protection in '76 by town. **Water Supply.**—Credit river, pumping to reservoir and direct. **Pumping Machinery.**—Dy. cap., not given; two Holly rotary. **Reservoir.**—Cap., 110,000 galls.; 25 x 50 ft., x 12 ft. deep. **Distribution.**—*Mains*, c. i., 1 mile. *Hydrants*, 10. *Pressure*, 50 to 110 lbs. **Financial.**—Cost, $10,000. Debt, $10,000. Int., 6%. Ann. op. exp., $1,000. No rev. **Management.**—Supt., Dr. Carbet. Pumpg. Engr, Thos. Robinson.

NOTE.—No report for '89 could be obtained.

OTTAWA, *Carleton Co.* (Pop., 27,417; est., 36,000.) At junction of Ottawa and Rideau rivers. Has sewers and electric lights.

History.—Built in '72-4 by city. Engr., Thos. C. Keefer, Ottawa. Contrs. for masonry and foundations, Ryan & Booth; for buildings, B. Gibson.

Water Supply.—Ottawa river, by direct pumping, water for power being conveyed through open canal to pump-house, and for consumption, through wooden conduit laid in bottom of canal.

The point of supply is above Chaudiere Falls, at point where river has strong current and rocky bed. Falls are from 25 ft. high at low water to 35 ft. at high water.

For over 100 miles above city river is a succession of large, deep lakes and rapids.

Canal.—Is 2,500 ft. long, cut through solid rock, with av. depth of 16 and width of 20 ft., giving depth of 13 ft. below low water at head level. Entrance to canal is formed by two lines of stone-filled timber crib-work, each 20 ft. wide by about 200 ft. long, and 25 ft. deep at river end, placed 60 ft. apart. Booms protect head of entrance, and rack with double stop-gates is built about midway in their length. Each gate has 20-ft. opening, with grooves for receiving logs forming stop-gates; gates are separated by central pier containing well with screens, from which domestic supply conduit is fed. Second stop-gate is located down canal. At pump house canal is stopped by curved dam, and waste weir, both of masonry, carried above flood level.

On each side of canal, rock is cleaned off for several feet, and drainage is conducted from canal. One railway and 4 roadway bridges cross canal, all of stone. No provision was made for emptying or cleaning canal.

Wooden Conduit: has an internal diam. of 30 ins., and is of 2-in. pine staves, hooped every 4 ft. with ⅜ x 3-in. iron, except at anchorage points, where hoops are of ⅝-in. iron. Conduit is laid in a trench 1 x 3 ft., dug in bottom of canal. At every 12 ft. the conduit is anchored to rock bed by 1-in. iron eye bolts, hole first being driven in rock, and soft pine treenail, with diam. ¼-in. less than drill-hole inserted, and bolt driven home. Through this, lifting strain of 2½ tons was applied to each bolt, but none stirred.

Changes in direction of wooden conduit are made by c. i. angle joints. Cost $3.00 per ft., against $9.15, the price at that time for suitable iron pipe.

Pumping Machinery.—Dy. cap., 16,000,000 galls., including new; three 2,000,000-gall. sets of single-acting water-power pumps, driven by 61-in. double Leffel turbines; first two sets were furnished by Jos. Hall Mfg. Co., and third by Victoria Foundry (N. S. Blaisdell & Co.), Ottawa. Contracts were let in '88 to Canadian Locomotive & Engine Co., Ltd., Kingston, for 10,000,000-gall. water-power pumps, which were completed about Nov. 1, 1889.

Distribution.—*Mains*, 63½ miles; about two-thirds of pipe used to end of '75 was imported from Scotland, and remainder furnished by R. D. Wood & Co., Philadelphia, Pa. To end of '75 there had burst 66 lengths of Scotch to 7 of American pipe. Scotch pipe had turned and bored joints, American, bell and socket, leaded, and to end of '75 on 32 joints Scotch pipe had leaked, to 25 on American. *Services*, lead. *Taps*, 7,512. *Meters*, 18. *Hydrants*, Mathews, 431. *Pressure-recording gauge*, Edson.

Close of '80: Mains, 43 miles. Taps, 5,656. Meters, none. Hydrants, 327.

Consumption, 4,000,000 galls. *Pressure:* Ordinary, 90 lbs. Fire, 110 lbs.

Financial.—Cost, $1,185,007. Bonded debt, $1,150,000: $1,0 0,000 at 5, $150,000, in '89, at 4½%. Sinking fund, $11,800. Ann. op. exp., $177,004, including cost of improvements, about $50,000. Ann. rev.: consumers, $133,105.

Cost, close of '80, $1,044,682. Rev., '80, $91,412.

Management.—Com. of six Aldermen. Secy. and Supt., Robt. Surtees. Collector, Edw. Pinard. Treas., Thos. H. Kirby.

NOTE.—A detailed description of these works, as originally construct d, with itemized cost, is given in *Engineering News*, Vol. V., pp., 51, 62, 75 and 90.

OWEN SOUND, *Grey Co.* (Pop., 4,226; est., 6,600.) Incorp. Has sewers and electric lights.

History.—Built in '80 by Parker & Norther; known as Owen Sound Water-Works Co. Des. Engr., Jno. Kennedy, Owen Sound. Labor done by day.

Water Supply.—Springs, 2¼ miles from, and about 170 ft. above town, by gravity.

Reservoir.—Cap., 1,000,000 galls.

Distribution.—*Mains*, c. i., 12 miles. *Services*, lead, iron. Pipe and specials from Don Foundry, Toronto. *Taps*, 200. *Meters*, 8. *Hydrants*, "Ottawa patent," 28.

Consumption, 50,000 galls. *Pressure*, 70 lbs.

Financial.—Cost, $60,000. No debt. Ann. op. exp., $1,200. Ann. rev.: consumers, withheld, est., $2,500; city, $1,400. Hydrant rental, $50.

Management.—Proprietors, Parker & Norther. Mgr., S. J. Parker.

NOTE.—Above same as in MANUAL for '88, L. J. Parker reporting "no change.'

PAISLEY, *Bruce Co.* (Pop., 1,350; est., 1,500.)

History.—Built by town for fire protection. Engr., — Miller, Walkertown. Contr., Osborne & Kelly, Hamilton. Water Supply.—River, by direct pumping. Pumping Machinery.—Dy. cap., 15,000 galls.; make not given. Distribution.—*Mains*, 8 to 6-in., 2,200 ft. *Hydrants*, 6. *Pressure*, 100 lbs. Financial.—Cost, $7,500. No rev. Management.—Engr., W. W. Brown.

PARIS, *Brant Co.* (Pop., 3,300; est., 3,700.) In a valley, between Grand river and Smith's creek. Incorp. village in '50; town in '56. No sewers. Has electric lights.

History.—Built in '83-4 by town. Des. Engr., A. Ware. Const. Engrs., J. A. Bell, St. Thomas, and W. Larery, Dundas. Contrs., J. J. Blackmore & Co., St. Thomas.

Water Supply.—Spring on Smith's creek, one mile from town, pumping to reservoir.

Pumping Machinery.—Dy. cap., 1,083,000 galls.; one 722,000-gall. dup. and one 361,000-gall. single pump, both from Northey & Co., Toronto.

Reservoir.—Cap., 1,250,000 galls.; 100 ft. sq. at bottom, 136 ft. sq. at top, 12 ft. deep, 140 ft. above lower part of town.

Distribution.—*Mains*, c. i., 4 miles. *Services*, lead. Pipe and specials from Alex. Gartshore, Hamilton. *Taps*, 221. *Meters*, none. *Hydrants*, 25.

Consumption, 150,000 galls. *Pressure*, 40 to 200 lbs.

Financial.—Cost, $45,715. Debt, $35,297. Int., 6%. Sinking fund, $1,200. Ann. op. exp., $1,200. Ann. rev.: consumers, $2,690; city, $1,250. Hydrants, free.

Management.—Chn., T. McCosh. Town Clerk, S. Dodson.

PETERBOROUGH, *Peterborough Co.* (Pop., 6,815; est., 9,000). On Otonabee river, which falls 50 ft. in passing through town. Engaged in manufacturing and lumber trade. Incorp. No sewers. Has electric lights.

History.—Built in '82 and put in operation in Jan., '83, by Peterborough Water Co. Des. Engr., Robt. Surtees, Ottawa. Const. Engr., J. E. Belcher. Labor done by local Contrs.

Water Supply.—Otonabee river, by direct pumping.

Dam.—Of timber, 350 ft. long, cribbing of stone.

Filter.—Charcoal and gravel.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two Knowles double-acting, 14 x 16-in. water-power. *Water-wheels:* two 33-in. Little Giant, under 12 ft. head and fall.

Distribution.—*Mains*, c. i., 8¼ miles; from Laidlaw & Son, Glasgow, Scotland, and Alex. Gartshore, Hamilton. *Services*, lead. *Taps*, 400. *Meters*, 4. *Hydrants*, 65. Valves and hydrants from Ludlow Valve Co., Troy, N. Y., and A. Doig, Toronto.

Consumption, 500,000 galls. *Pressure:* Ordinary, 75 lbs. Fire, 110 lbs.

Financial.—Cost, $90,000. Debt (in '87), $65,000. Int., 6%. Ann. op. exp. (in '87), $8,500. Ann. rev. (in '87): consumers, $5,500; city, $3,100. Hydrant rental, $50 and $40; 10-years contract.

Management.—Prest., Jno. Burnham. Supt., Wilson Henderson.

PICTON, *Prince Edward Co.* (Pop., 2,975; est., 4,000.) On Bay of Quinte. Incorp. town. No sewers. Has electric lights.

History.—Built in '89 by town for all but culinary and drinking purposes; put in operation Dec. 10. Const. Engr., C. Booth, Kingston. Contrs., E. L. de Laville & Co., Montreal. Water Supply.—Bay of Quinte, pumping to reservoir. Water not fit for culinary use or drinking. Pumping Machinery.—Dy. cap., 400,000 galls.; Worth-

ington comp., dup. **Reservoir**.—Cap., about 700,000 galls.; 100 ft. sq., 10 ft. deep **Distribution**.—*Mains*, 8 to 4-in., iron, 4½ miles. *Meters*, none. *Hydrants*, 32. *Pressure*, 60 lbs. **Financial**.—Cost, about $29,000. Bonded debt, $30,000. Int., 5%. Bonds sold at 108.94. **Management**.—Address Mayor or Council. Report, Feb. 11, '90.

PORT HOPE, *Durham Co.* (Pop., 5,588; est., 5,720.) On Lake Ontario, at mouth of Smith's creek. Business part of town is in valley, and residence sections on hills. Settled in 1793; incorp. town in '50. No sewers. Has electric lights.

History.—Built for fire protection in '74 by town. Engr. and Contr., Jno. Helm, Jr., Port Hope. **Water Supply**.—Smith's creek, by direct pumping from mill-pond. **Pumping Machinery**.—Dy. cap., not given; rotary pump made by Wm. Hamilton. **Distribution**.—*Mains*, 10 to 6-in. c. i., about 2 miles. *Hydrants*, kind not given, 32. *Pressure*, 120 to 250 lbs **Financial**.—Cost, $18,000. No debt. Ann. op. exp., $250. No rev. **Management**.—Town Clerk, H. V. Sanders. Supt., Jno. Gamble.

NOTE.—In '89 there was a proposition before the Council to introduce system for domestic supply; water to be taken from Lake Ontario and pumped to reservoir on hill.

SAINT CATHARINES, *Lincoln Co.* (Pop., 9,642; est., 11,000.) Engaged in manufacturing Incorp. Partially sewered. Has electric lights.

History.—Built in '76-7 by city. Des. Engrs., Thos. Monro, and Louis H. Knapp; latter is of Buffalo, N. Y., and was also Const. Engr. Consult. Engr., Thos. C. Keefer, Ottawa. Contrs., Ferguson, Mitchell & Symmes.

Water Supply.—Beaver Dam creek, by gravity from reservoir.

Dams and Reservoir.—Cap., 40,000,000 galls.; area, 9¾ acres; av. depth, 20 ft.; 285 ft. above Lake Ontario, 174 ft. above av. level of city. Formed by building two dams across creek, and carrying surplus water from above upper dam around reservoir to natural channel below lower dam. Pipes beneath upper dam supply reservoir. Lower dam 500 ft. up-stream from De Cew falls. *Upper Dam:* floods area of about 45 acres, and serves somewhat for storage; clay, excavated from reservoir; 462 ft. long, 28 ft. high, 12 ft. wide at top, 125 at bottom, water 9 ft. below top. Slopes, 2 to 1, both probably, upper certainly, paved to short distance below water line. *Feed Pipes:* two 20-in. extend beneath dam to feed lower reservoir. *Spillway:* 45 ft. wide, 1,369 ft. long; 70 to 130 ft. from dam, in excavation of hard clay and in embankment; stone paving where in embankment; free; slope 1 ft. in 1,369.

Lower Dam: clay, like upper, 429 ft. long, 31 ft. high, 12 ft. wide on top, 160 at bottom, water 5 ft. below surface. Water, 25 ft. deep at dam, at deepest point; av. depth, 20 ft. Inner slope, 2 to 1 for 10 ft., vertically, from top, then berme 5 ft. wide then slope of 3 to 1; paved to berme, which is about 5 ft. below normal water level. Outer slope, 2 to 1, unpaved. *Discharge-pipes:* two 20-in. drain, besides supply main. Drain pipes will draw water down 20 ft below normal line, and all thre. leave reservoir through bank at side of reservoir, and not through dam. Engrs. and Contrs., see History.

Distribution.—*Mains*, 30 to 4-in., c. i., 22½ miles; from Yale & Co., St. Catharines, and Alex. Gartshore, Hamilton. *Taps*, 1,255. *Meters*, 8. *Hydrants*. Burow & Chatfield, 16%. *Valves*, Eddy. *Close of* '80: Mains, 15½ miles. Taps, 538. Meters. 2. Hydrants, 123.

Consumption, 500,000 galls. *Pressure*, 75 lbs.

Financial.—Cost, $322,321. Bonded debt, $275,000 Int., 6%. Ann. op. exp., $3,000. Ann. rev.: consumers, $8,500. Cost, close of '80, $275,000. Rev., '80, $1,320.

Management.—Chn., L. S. Oille. Supt., J. Albert Mills.

SAINT JEROME, *Terrebonne Co.* (Pop., est., 3,500.) Incorp. town. No sewers. Has electric lights.

History.—Built in '79-80 by town. Const. Engr., Evangelisto Dupras. Contr., Jos. LaChapelle, St. Jerome.

Water Supply.—Spring, by gravity,

Distribution.—*Mains*, wood, 7½ miles. *Services*, wood.

Financial.—Cost, $20,000. Ann. op. exp., $400. Ann. rev.: total, about, $4,000.

Management.—Mayor and Supt., J. J. H. Leclaire.

SAINT THOMAS, *Elgin Co.* (Pop., 9,500; est., 10,300.) On Kettle creek, 7 miles from Lake Erie, in very uneven country. Engaged in manufacturing. Incorp. city in '81. Has sewers and electric lights.

History.—Built in '74 by town. Committee appointed in '89 to arrange for additional supply of water for domestic use. Well 6 ins. in diam., 212 ft. deep, was sunk, but water contained so much sulphur it could not be used. Committee investigated springs, 5 miles from city; result not reported.

Water Supply.—Kettle creek, by direct pumping from impounding reservoir.
Dam and Reservoirs.—Not described.
Pumping Machinery.—Dy. cap., 600,000 galls.; two horizontal pumping engines, make not given, and one 350,000 Worthington. *Boilers:* two.
Distribution.—*Mains*, c. i., 5 miles. *Services*, w. i. *Taps*, 359. *Meters*, 4. *Hydrants*, Holly, 56. *Valves*, Ludlow.
Consumption, 340,000 galls. *Pressure:* Ordinary, 45 lbs. Fire, 83 lbs.
Financial.—Cost, $70,000. No debt. Ann. op. exp., $3,920. Ann. rev.: consumers, $1,678.
Management.—Mgr., Jas. A. Bell.

SARNIA, *Lambton Co.* (Pop., 5,000; est., 5,800.) On St. Clair river, 2 miles below the foot of Lake Huron. Settled in '30. Incorp. town in '57. Has sewers. No electric lights.
History.—Built in '75-6 by town. No Des. Engr. Const. Engr., Robt. Turner, the present Supt. Labor done by local Contrs., and by day.
Water Supply.—St. Clair river, by direct pumping.
Intake.—A 20-in. iron pipe, 200 ft. long.
Pumping Machinery.—Dy. cap., 1,500,000 galls.; 4 Walker, driven by high-pressure horizontal engines.
Distribution.—*Mains*, 12 to 4-in. c. i., w. i., 17¼ miles; from R. D. Wood & Co., Philadelphia, Pa., for construction; for extensions, from A. Gartshore, Hamilton, and T. T. Turnbull. *Services*, lead, and 1¼ to 1 in. w. i., 2¾ miles. *Taps*, 954. *Meters*, 3. *Hydrants*, Mathews, 100. *Valves*, Ludlow.
Consumption, 601,910 galls. *Pressure:* Ordinary, 35 lbs. Fire, 80 to 120 lbs.
Financial.—Cost, $71,300. Debt, 49,300; outstanding debentures, $48,000. Int., 5%. Ann. op. exp., $3,997. Ann. rev.: consumers, $8,606.
Management.—Com. from Council. Engr. and Supt., Robt. Turner.

SEAFORTH *Huron Co.* (Pop., 2,600; est., 3,000.) Engaged in manufacturing.
History.—Built for fire protection and lawn sprinkling in '79-80 by town. Engrs. and Contrs., Inglis & Hunter, Toronto, who furnished all material. Sub-contr. for masonry and buildings, Wm. Copp; for reservoir, Jas. Walsh & Wm. Sherrill. **Water Supply.**—Spring creek, by direct pumping. **Reservoirs.**—Cap., 182,000 galls.; two, one 50 x 80 ft., x 5½ ft. deep with cap. of about 144,000 galls.; one 20 x 50 ft., x 5½ ft. deep, with cap. of about 38,600 galls. **Pumping Machinery.**—Dy. cap., 1,500,000 galls.; from Contrs. **Distribution.**—*Mains*, c. i., 1¾ miles. *Hydrants*, from Contrs., 13. **Financial.**—Cost, $11,000. Debt, $5,550. Int., 6%. Ann. op. exp., $465. Ann. rev.: consumers, $450. **Management.**—Chn. Com., A. Strong. Chf. Fire Dept., Jas. R. Wright.

SHELBURNE, *Grey Co.* (Pop., est., 1,300.) Engaged in manufacturing.
General Description.—Under construction in '89 by village. About Aug. 15, '89, well had been sunk, but not thoroughly tested, and construction of windmill and tank begun. Water was to be pumped by windmill to tank 110 ft. above town. Contrs. for well, tank and windmill, Ontario Pump Co.; price, $8,000. Bonds authorized, $12,000. Clerk of Council, F. G. Dunbar.

SMITH'S FALLS, *Lanark Co.* (Pop., 2,087; est., 4,000.) On Rideau canal. Engaged in manufacturing. Incorp. Has sewers and electric lights.
History.—Built in '87 by A. Foster. Engr., —— Henderson, Smith's Falls. Contr., Geo. Dana, Brockville.
Water Supply.—Rideau river, pumping to tank.
Pumping Machinery.—Dy. cap., 1,000,000 galls.; one 10 x 12-in. water-power, from Northey & Co., Toronto, and one dup. steam.
Tanks.—Cap., 40,000 galls; at elevation of 120 ft.
Distribution.—*Mains*, 6-in. c. i., 3 miles. *Services*, w. i. *Taps*, 75. *Meters*, none. *Hydrants*, Beckett, 4. *Valves*, Beckett.
Consumption, 200,000 galls. *Pressure:* Ordinary, 65 lbs. Fire, 100 lbs.
Financial.— Cost, $10,000. No debt. Ann. op. exp., $300. Ann. rev.: consumers, $1,400; city, $200. Hydrant rental, $50.
Management.— Owner, A. Foster.

STRATFORD, *Perth Co.* (Pop., 9,000; est., do.) On irregular ground on River Avon. Settled in '34; incorp town in '58. Has sewers and electric lights.
History.—Built in '89 by Stratford Water Supply Co. Engr., Jno. M. Moore, London.

Water Supply.—River Avon, pumping direct.

Water now taken from river 3,000 ft. further up than in '89, to avoid swamp stream. For old dam and filter basin see MANUAL for '88, p. 560.

Conduit.—To pump-wells; 15-in, sewer pipe.

Pumping Machinery.—Dy. cap., 2,500,000 galls.; two 1,250,000 Worthington comp., dup. Additional pump of 3,000,000 galls. cap., and 100-H. P. boiler projected in '90.

Distribution.—*Mains*, c. i., 11 miles. *Services*, lead. Pipes and specials, valves and hydrants from, and trenching and pipe-laying done by, Cakus & Drummond, London. *Taps*, withheld. *Meters*, 1. *Hydrants*, 72.

Consumption, 500,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 80 lbs. and more.

Financial.—Cost, $77,269. Cap. stock, $35,000. Debt, $13,000: $3,000 at 6, $40,000 of bonds at 5%. Ann. op. exp., $4,610. Ann. rev.: consumers, $6,797; city, $3,820. Hydrant rental, $53.

Management.—Prest. and Supt., Jno. Corrie. Mgr., Thos. Clark. Secy., and Treas., D. B. Burritt.

TILBURY CENTRE, *Kent Co.* (Pop., est., 1,000 to 1,300.) Incorp. No sewers or electric lights.

History.—Built in '88 by town. Engr., Jas. A. Bell, St. Thomas. Contrs., J. Currie & Co., London.

Water Supply.—Lake St. Clair, pumping direct. Water conveyed from lake through an artificial channel, 1½ miles, thence by 12-in. pipe to pump-house.

Pumping Machinery.—Dy. cap., 750,000 galls.; one dup. pump from Hughes Bros., Cleveland, O. Steam is supplied and pump run by a mill owner for $400 a year.

Distribution.—*Mains*, c. i., 1½ miles. *Services*, w. i. *Taps*, 12. *Meters*, none. *Hydrants*, Mathews, 9. *Valves*, Ludlow.

Consumption, 30,000 galls. *Pressure:* Ordinary, 30 lbs. Fire, 80 lbs.

Financial.—Cost, $12,000. Debt, $12,000; payable $600 yearly. Int., 5%. Ann. op. exp., $400. Ann. rev.: consumers, $760; $700 comes from Michigan Central Ry., 10 years' contract.

Management.—Mgr., J. S. Richardson. Supt., J. S. Stewart.

TILSONBURG, *Oxford Co.* (Pop., 2,000; est., 2,600.) Has manufactories. Has electric lights.

History.—Built for fire protection in '75 by town. **Water Supply.**—Surface water, by direct pumping. **Pumping Machinery.**—Dy. cap., not given; two 60-H. P. rotary water-power. *Water Wheel:* turbine, under 28 ft. head. **Distribution.**—*Mains*, 8 to 4-in. iron, 1.9 miles. *Hydrants*, Holly, 24. *Pressure*, 100 lbs. **Financial.**—Cost, $40,000. Debt, $19,000. Int., 6%. Ann. op. exp., $500. No rev. **Management.**—Engr., P. McFarlane. Report by W. McDonald, Chf. Fire Dept.

TORONTO, *York Co.* (Pop., 86,445; est., 126,000.) On Lake Ontario, on plain rising gently from lake for about 2 miles, and then rising more abruptly to range of hills. Settled in 1794 as York; name changed to Toronto in 1799. Parkdale annexed in '89, as St. Alban's ward. Has sewers and electric lights.

WORKS FROM '41 TO THEIR PURCHASE BY THE CITY IN '73.

General Description.—Built in '41, when pop. was about 20,000, by —— Furniss. A 21-years contract was made with city for fire protection. Water was pumped from lake, at point opposite city, to stand-pipe and to St. George's and Cover Hill reservoirs. First pumping machinery consisted of engine with 21-in. cylinder of 5½-in. stroke, driving two single-acting pumps of 8-in. bore and 72-in. stroke.

In '51 works were sold to a Co., but they soon reverted to Mr. Furniss.

In '56-7, pumping engine was added, with 32-in. steam, and 21-in. water cylinder, both of 72-in. stroke. To this time the works had cost about $160,000, and were paying good dividend. In '70 a comp. engine was built, with 22 and 38-in. cylinders of 48-in. stroke, and driving bucket and plunger pump of 27¼-in. diam. and 48-in. stroke. In '73 city bought the works for $200,000. There were then 20.77 miles of pipe, 7 miles being w. i. and cem., and the rest c. i.

PRESENT WORKS.

History.—Built in '73-8 by city, retaining parts of old works. Construction was in charge of special commission, of which Peter Alexander Peterson was Chf. Engr., and Thos. C. Keefer, E. S. Chesbrough and John Kennedy, Consult. Engrs. In '89 Parkdale works were merged into these, owing to annexation. [Pumping station was probably retained.] See MANUAL for '88, p. 558. In '89 contracts were let for improvements; total price, $577,587.

Water Supply.—Lake Ontario, pumping to reservoir. For description of old filter basin see MANUAL for '88, p. 561.

Present Intake—Includes old intake conduit from filter basin to pump-well, and eqtension to new intake crib.

Old Part of Intake.—Of wood, from north arm of old filter basin (not in use) for 6,007 ft. across Block House bay to Gibraltar point, where crib forms connection with c. i. pipe, leading to pump-well.

Wooden conduit has internal diam. of 4 ft., and is of altenate staves of green oak and pine, each 3 ins. thick, 6 ins. wide and 16 ft. long, bound every two feet with iron hoops, 3 ins. wide. First 1,400 ft. was sunk continuously, a scow and sloping framework being drawn forward from under it as it was built. Trench could not be kept clear of sand, and conduit had to be relaid, 200-ft. sections being adopted for this and remaining distance. The 200 ft. sections were joined with iron flanges, bolted by divers.

Part of wooden conduit was not properly covered with sand, and in Dec., '75, when pumping through it began, it rose to surface. It was taken up, trench dredged, and conduit relaid, and covered with 2½ ft. of sand, since which it has remained in place.

This part of conduit terminates in crib at Gibraltar point, and when conduit floated an opening was made in the crib and water admitted to it, and thus to and through the 36-in. submerged c. i. pipe, with Ward's flexible joints, leading for 4,441 ft. to a crib 700 ft. from the esplanade along the city harbor front.

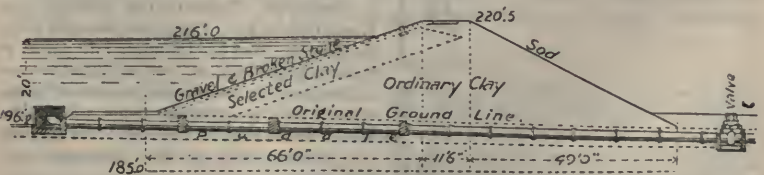
From latter crib 200 ft. of iron pipe conveys water to pump-well, which is 200 ft. from esplanade, and has its foundation carried to rock, 6 to 9 ft. below water surface.

Lake Extension.—New conduit is 2,357½ ft. long, leading from outer end of old conduit to crib in 26 to 30 ft. of water. Crib is 40 ft. sq., has double walls of 12-in. timbers, bolted with 1¼-in. iron, and a compartment 10 ft. sq. in center, into which conduit opens. Conduit has internal diam. of 6 ft., is of 6 x 5-in. oak staves in sections, banded every 2 ft. with welded w. i. hoops ¾ ins. thick, and 3 in. wide. Staves have av. length of 14½ ft., and butt joints are completed by 3-16 x 1-in. iron tongues let into ends of the staves. Sections were 100 ft. long, after 200 lengths proved unwieldy. They were joined by flanged castings, fastened by ⅞-in. bolts, joints packed with wood. When not sufficiently loaded with covering of sand there were placed every 100 ft. stone-filled cribs 22 ft. sq., similar in construction to large intake crib.

Av. cost of building and placing 100-ft. sections of 6-ft. conduit, including loading cribs, was $64.24; and of 200-ft. sections, without cribs, $37.93 per 100 ft. For cross-sections and details of 6-ft. lake extension, and longitudinal section of whole intake conduit, see Report of Supt. for '87.

New Conduit.—Lake to pump-well; contracted for in '89; 4,600 of 48-in., 6,000 ft. of 60-in. steel.

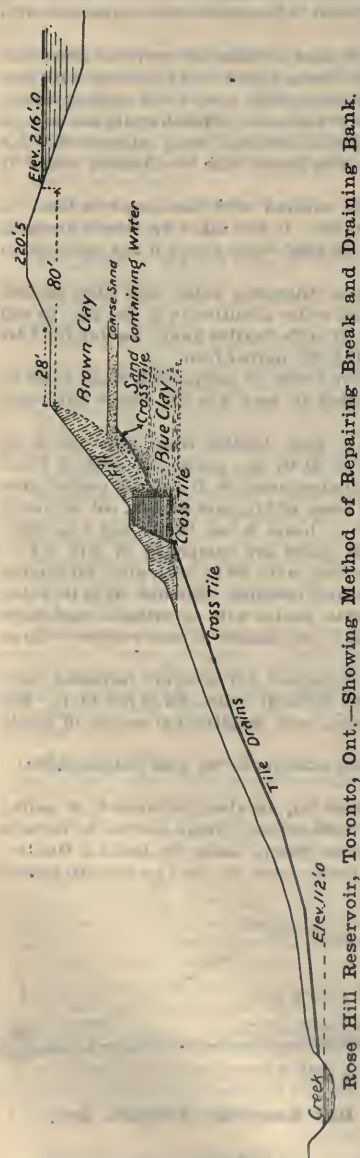
Pumping Machinery.—Dy. cap., 22,000,000 Imp. or about 26,000,000 U. S. galls.; a 5,000,000-gall. pump erected in '74, and a 10,000,000-gall. pump erected in '76, both Worthington comp., and a 5,000,000-gall. Martin pump, made by Inglis & Hunter. Return tubular boilers are used. In '89 contracts were let for two 3,000,000 pumps for high service.



Cross-Section, South Bank, Rose Hill Reservoir, Toronto, Ont.

Rose Hill Reservoir.—Cap., 30,473,600 Imp., or 40,168,320 U. S. galls.: water area, 9.56 acres: depth, 20 ft., in excavation and embankment. Bank 10 ft. wide on top; inner slope, 3 to 1. Bottom and slopes covered with 6 ins. of broken stone overlaid with 12 ins. of gravel. Inlet pipe laid beneath embankment, and at foot of the inner slope is turned up for 2 ft. with a bell-mouth. It was laid in puddle, with 3 brick masonry collars, 1-ft. thick, projecting 1 ft. Slides occurred on outer slope in '76,

which were repaired by building cribwork and filling in, Further slides were guarded against by under drainage. All of which is shown, together with section through embankment, at discharge-pipe, in accompanying illustrations. Built in '73. Des. Engr., P. Alex. Peterson. Const. Engr., R. I. Brough. Contr., Robt. Mitchell.



Rose Hill Reservoir, Toronto, Ont.—Showing Method of Repairing Break and Draining Bank.

Distribution.—*Mains*, c. i., w. i. and cem., 182.62 miles; only c. i. pipe has been laid since new works were built, and no pipe less than 6-in. is now laid. *Services*, lead, galv. i. *Taps*, 29,883. *Meters*, 889. *Hydrants*, Mathews, 1,954. *Valves*, "department design."

Consumption, 11,045,679 galls. *Pressure*, av., 90 lbs.

Jan. 1, '80, there were 111.29 miles of mains, 8,563 taps, 49 meters, 47 hydraulic elevators and 1,070 fire hydrants. The consumption in '70 was 1,500,000 galls., and in '79, 4,660,000 U. S. galls.

Financial.—Cost, $2,971,600. Debt, $2,643,000: $1,999,000 at 6; $65,000 at 5; $579,000 at 4%. Sinking-fund and int., $163,000. Ann. op. exp., $135,706. Ann. rev.: consumers, $316,920; city, $97,132. Hydrant rental, $30.

Management.—Supt., W. Hamilton. Secy., Chas. Mathews. Pumpg. Engr., J. C. Ferguson.

References.—"Report Regarding Water Supply by Gravitation." Submitted Nov. 28, '87, by C. Sproatt, City Engr., and Alan Macdougal, Asst. City Engr. Published as appendix to Report of Supt. for '87.

"Report on Proposed Water Supply by Gravitation." By Wm. J. McAlpine, deceased, and Kivas Tully. Dated Feb., '87.

"Report on the Extension of the Water Supply and on the Disposal of the Sewage of the City of Toronto." By Rudolf Hering, N. Y. City, and Saml. M. Gray, Providence, R. I. Pamphlet, 31 pp., and large maps and profiles. Dated Feb. 15, '89.

TRENTON, *Hastings Co.* (Pop., 2,300; est., 5,500.) On Trent river, at head of Bay of Quinte. Has electric lights.

General Description.—Owned by Hugh O'Rourke. Water is conveyed from springs by gravity through one mile of wooden pipes laid in the principal streets At frequent intervals small tanks or casks, are set in the ground, from which the water is continually running. Cost, $1,000. Cap. stock, about $2,000. Address Hugh O'Rourke.

UXBRIDGE, *Ontario Co.* (Pop., est., 1,800.) Has manufactories. Has electric lights.

History.—Built for fire protection in '74 by town. Const. Engr., W. Wilson, Uxbridge. **Water Supply.**—Creek, by direct pumping. **Pumping Machinery.**—Dy. cap., 1,537 galls.; two Waterous. **Distribution.**—*Mains*, c. i., 3 miles. *Hydrants*, 6 made by Waterous, 4 by St. Lawrence Foundry, Toronto, 4 by Whitelaw, Woodstock, 14. *Pressure*, 140 lbs. **Financial.**—Cost, $15,000. No debt. Ann. op. exp., $300. **Management.**—Engr., W. McGuire.

WALKERVILLE, *Co. not given.* (Pop., 600; est., 1,000.) Not incorp. Has sewers and electric lights.

History.—Built by Hiram Walker & Sons, date not given. Des. Engr., Frank E. Kirby, Detroit.

Water Supply.—Source not given, pumping direct.

Pumping Machinery.—Dy. cap., 6,000,000 galls.; 3,000,000 Worthington pattern dup.; two, 1,500,000; all from Kerr Bros., Walkersville.

Distribution. — *Mains*, c. i., 4 miles; from Alex. Gartshore, Hamilton. *Hydrants*, 30.

Financial.—Cost, $60,000.

Management.—Owners, Hiram Walker & Sons. Report, June 24, '89.

WELLAND, *Welland Co.* (Pop., 1,870; est., 2,000.) On Welland river and canal. Has water-power. Eight miles from Lake Erie. Incorp. Partially sewered. Has electric lights.

History.—Built in '88 by town. Engr., Wm. Kennedy, Owen Sound.

Water Supply.—Welland canal, pumping direct.

Pumping Machinery.—Dy. cap., 2,250,000 Imp. galls.; two sets of water-power pumps; each set consists of three single-acting, brass, plunger pumps of 22-in. stroke, connected by spur and bevel gears, with a 200-H. P. New American turbine.

Distribution.—*Mains*, 8 and 5-in. c. i., 4 miles. *Taps*, 129. *Meters*, none. *Hydrants*, 30.

Consumption, unknown. *Pressure:* Ordinary, 60 lbs. Fire, 150 lbs.

Financial.—Cost, $47,000. Debt, $48,000; "$1,000 on hand." Int., 5%. Sinking fund $743 per annum. Ann. op. exp., $500. Ann. rev.: consumers, $1,500; city, $1,200, Hydrant rental, $40.

Management.—Water Com. Secy., J. H. Burgar. Supt., J. F. Gross.

WEST TORONTO JUNCTION, *York Co.* (Pop., est., 5,000.) Is ¾ miles from Toronto.

General Description.—Built by McQuillan & Co., Toronto, date not given. Engr., J. H. Venables. Supply, Lake Ontario. Cost, $100,000. Address Jno. D. Spears or Asst. Supt., A. H. Clemens. Report, Oct. 22, '89.

WIARTON, *Bruce Co.* (Pop., 916; est., 2,000.) On Georgian bay. Incorp. No sewers or electric lights.

History.—Built in '88-9 by town for fire protection. Engr. and Contr., John D. Ronald, Brussels. Water Supply.—Georgian bay, pumping to stand-pipe and direct. Pumping Machinery.—Dy. cap., 750,000 galls.; one comp., rotary, dup. horizontal double-acting plunger pump, made by Contr., after Worthington type. *Boilers:* of steel, 12 ft. long. Stand-Pipe.—Cap., not given; 2¾ x 100 ft. Distribution.—*Mains*, 6-in. c. i., 3,500 ft. *Hydrants*, 16. *Pressure:* Ordinary, 40 to 50 lbs. Fire, 125 lbs. Financial.—Cost, $15,000. Debt, $15,000. Int., 5%. Ann. op. exp., about, $1,000. Management.—Town council. Report by John D. Ronald, Brussels, Ont.

WINDSOR, *Essex Co.* (Pop., 7,000; est., 9,500.) On Detroit river. Incorp. town. Has sewers and electric lights.

History.—Built in '72-3 by city. Des. Engr., F. L. Foster. Const. Engrs. and Contrs., Waterous Engine Works, Brantford. Sub-Contr., for masonry and buildings. Jas. Bartlett, Windsor.

Water Supply.—Detroit river, by direct pumping.

Pumping Machinery.—Dy. cap., 4,500,000 galls.; Waterous engine and rotary and plunger pumps in use in '89, but were to be replaced by 3,000,000-gall. dup., comp., cond. pump from Kerr Bros., Walkerville.

Distribution.—*Mains*, 16 to 6-in. c. i., 28 miles; from St. Rolloc Works, Glasgow, Scotland; 3 miles laid in '89, from Canada Pipe Foundry, Hamilton, Ont. *Services*, lead. *Taps*, 2,500. *Meters*, 2. *Hydrants*, 200. *Close of '89: Mains*, 19 miles. *Taps*, 1,500. *Meters*, 1. *Hydrants*, 150.

Consumption, 1,000,000 galls. *Pressure:* Ordinary, 40 lbs. Fire, 90 to 120 lbs.

Financial.—Cost, $180,000. Debt, $155,000; to be canceled in equal annual payments. Int., 6%. Ann. op. exp., $8,000. Ann. rev.: consumers, $21,000; city, $2,000. Cost, close of '89, $127,000. Rev., '89, $16,051.

Management.—Comrs. Chn., Jno. Curry. Secy., C. Reid. Chf. Pumpg. Engr., Jos. Hall.

WINGHAM, *Huron Co.* (Pop., 2,400; est., do.) On Maitland river, which furnishes water-power.

History.—Built in '80 by town [probably] for fire protection. Engr., T. H. Tracy, London. Contr., A. J. Saxton, Toronto. **Water Supply.**—Maitland river, by direct pumping. **Pumping Machinery.**—Dy. cap., not given; two double-acting 10x15-in.; from Goldie & McCullough, Galt. **Distribution.**—(In '87.) *Mains*, 6-in. c. i. *Hydrants*, 6. *Pressure*, 120 lbs. **Financial.**—(In '87.) Cost, $8,000. Bonded debt, $8,000. Int., 6%. Ann. op. exp., $300. No rev. **Management.**—Supt., Geo. Pettypiece. Report by W. W. Inglis.

NOTE.—No report for '89 could be obtained.

WOODSTOCK, *Oxford Co.* (Pop., 6,300; est., 9,000.) On River Thames. Manufactures agricultural implements, wood and iron goods. Settled in '30; incorp. town in '51. Partially sewered; has electric lights.

History.—Built in '80 by town for fire protection and to supply manufactories. Des. Engr., Geo. Ware. In '89 Thomas C. Keefer was engaged to report upon complete works for domestic supply.

Water Supply.—Cedar creek, pumping direct.

Pumping Machinery.—Dy. cap., 1,500,000 galls; two 750,000 Worthington comp., of 10½x9 ins. *Boilers:* tubular.

Distribution.—*Mains*, c. i., 5¾ miles. *Services*, lead. *Taps*, 480. *Meters*, 25. *Hydrants*, Coffin, 79. *Valves*, Coffin.

Consumption, 100,000 galls. *Pressure:* Ordinary, 65 lbs. Fire, 100 lbs.

Financial.—Cost, $65,000. Debt, $65,000. Int., 4½%. Ann. op. exp., $3,000. Ann. rev.: consumers, $4,200.

Management.—Supt., Donald Munro.

Water-Works Projected With Fair Prospects of Construction.

BARRIE, *Simcoe Co.* (Pop., 4,854; est., 5,500.) On Kempenfeldt bay, Lake Simcoe. Summer resort. Has foundries, machine shops, woollen factories and electric lights.

Proposed Works.—Town to build in '90. Report submitted by Willis Chipman, Toronto, Jan. 15, '90. Supply, 8 artesian wells, about 4 ins. x 100 ft., pumping to 25 x 50 ft. stand-pipe. About 5 miles 10 to 4-in. pipe. Est. cost., $57,000. Address Mayor or Council.

Water-Works Projects Reported in '89 and '90, but Now Indefinite.

Galt, Waterloo Co. *Port Arthur*, District of Algoma, West; see MANUAL for '88, p. 564.

MANITOBA.

Water-Works Completed.

WINNIPEG, (Pop., 8,000; est., 25,000.) On Red river of the North and Assiniboine river in flat prairie country, with deep alluvial soil and clay substratum, overlying limestone rock. It is 640 ft. above sea level. Fort Garry was established here about '20, but until '72 place was small. Incorp. city in '74. Has electric lights.

History.—Built in '82 by Winnepeg Water-Works Co.

Water Supply.—Assiniboine river, by direct pumping.

Intake Tunnel.—Brick-lined, 3 ft. in diam., leading from river to pump-well.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; two double-acting pumps made by R. Laidlaw & Son, Glasgow, Scotland.

Filter.—National.

Distribution.—*Mains*, c. i. (in '87), 20 miles. *Services*, w. i. First mains were from Scotland, with turned and bored joints. The joints were liable to break. Later, hub and spigot joint were used. Pipe is laid 8 ft. deep. *Taps*, withheld, est., 800. No hydrants.

Consumption, not given. *Pressure*, 45 lbs.

Financial.—Cost, $130,000. In '84 authorized cap. stock was $300,000, of which $150,000 was subscribed, and 55% of the latter paid up. Bonded debt (in '84, $60,000. Int. 6%. Ann. op. exp., withheld, est., $4,000. Ann. rev.: consumers, withheld, est., $15,000; city, none.

Management.—Prest., Alex. Moffet. Secy., A. B. Elford. Supt. and Res. Engr., J. E. Hannah.

Water-Works Projected with Fair Prospects of Construction.

DELORAINE. (Pop., est., 500.)

Proposed Works.—A 4-in. artesian well, down 1,340 ft., Feb. 12, '90. Hoped that flow would be obtained at 1,620 ft. Distribution may be put in if well is successful. Report by A. T. Stuart.

NORTH WEST TERRITORY.

Water-Works Projected with Fair Prospects of Construction.

CALGARY, *Alberta District.* (Pop., est., 4,000.) Engaged in mining and lumbering.

Proposed Works.—Calgary Gas & Water-Works Co. to build in '90. Supply, Bow river, pumping direct Est., cost, $70,000. Prest., P. McCarthy. Secy., A. Lucas. Report, Feb. 11, '90.

BRITISH COLUMBIA.

Water-Works Completed or in Process of Construction.

ESQUIMAULT. (Pop., not given.) Not incorp. No sewers or electric lights.

History.—Built by Esquimault Water-Works Co., date not given.

Water Supply.—Thetis and Upper Thetis lakes, by gravity. Area of lakes, 120 acres; av. depth, 22 ft.

Distribution.—*Mains*, c. i., 10 ins., down, 11 miles. *Services*, asphalted w. i. *Taps*, withheld. *Meters*, Siemens, 89. *Hydrants*, Mathews, 32. *Valves*, Guest & Chrimes.

Pressure, 74 lbs., static, at sea level.

Financial.—Cost, $125,000. Other data withheld. *Est.:* Ann. op. exp., $1,200. Ann. rev.: total, $15,000.

Management.—Prest. and Secy., T. Lubke, Victoria.

NANAIMO, *Vancouver Island.* (Pop., est., 3,000.) On Gulf of Georgia. Has coal mining industries. Incorp. city.

History.—Built in '86-7 by Nanaimo Water-Works Co.; put in operation Dec. 25, '87. Engr., J. W. Stirtan, Supt. No Contr.

Water Supply.—Spring-fed mountain stream, by gravity from impounding reservoirs.

Dams and Impounding Reservoirs.—Cap., 14,000,000 galls.; 323 ft. above lowest level of town. Two dams and reservoirs.

Distribution.—*Mains*, 6 to 3-in. c. i., 6 miles, not including supply. *Services*, ¾-in. galv. i. Pipe and specials from England. *Taps*, 200 *Meters*, Worthington, 6. *Hydrants*, Chapman, 28. *Valves*, Chapman.

Consumption, 150,000 galls. *Pressure*, av., about 100 lbs.

Financial.—Cost, $25,000. Cap. stock, paid up, $31,500. Ann. op. exp., $1,500. Ann. rev.: consumers, $7,000; city, none. Hydrants owned by city.

Management.—Prest., Jno. Marhar. Supt., J. W. Stirtan. Report, June 10, '89.

VANCOUVER, *New Westminster District.* (Pop., est., 8,500 to 15,000.) On Burrard Inlet, Pacific Ocean; has good harbor. Incorp. city in '86, when pop. was about 2,000. Previous to '86 there were but few houses here. Has sewers and electric lights.

History.—Built in '87-9 by Vancouver Water-Works Co., Ltd. Chf. Engr., G. A. Keefer. Rest. Engr., H. B. Smith.

Water Supply.—Capilano river, by gravity from impounding reservoir. River rises in mountains and flows through heavily timbered land. Min. dy. flow at point of discharge, determined during or prior to construction, 440,000,000 galls.

Dam and Impounding Reservoir.—Cap., 14,000,000 galls.; area, 6 acres; 380 x 700 ft.; 6½ miles from mouth of river, crest 417 ft. above lowest, 317 above av., 291 ft. above highest level of city, and 483 ft. above lowest depression in supply conduits. Dam, stone-filled timber cribs, 384 ft. long, 41 ft. 2 ins. wide at base, not including rear platform, 133¾ ft. high. For convenience in description may be divided into 4 parts, tumbling way or main dam, north abutment, containing gatehouse and appurtenances, south abutment, containing sluiceway, and north wing. *Tumbling Way:* 165 ft. long, 41 ft. 2 ins. wide, 153¾ ft. high in deepest part of old channel. Both abutments were partially completed before work on tumbling way was begun. As water could not be diverted from old channel without too great cost, work was carried on for some distance from each end, and embankment of sand and gravel was run diagonally up-stream from each end, the two meeting about 20 ft. above. This divided current of river, and forced water through horizontal openings left in sections already built, thus leaving but 3 ft. of still water in which remainder of work was done. There are 196 cribs in tumbling way, carefully filled, first with heaviest boulders obtainable, hoisted in, then with smaller stone and coarse gravel, latter rammed into crevices. Boulders found in excavating trench were blasted to columnar shape and left in position, forming excellent anchorage for cribs. Whole surface of tumbling way covered with 3-in. plank, jointed, laid close; upper half inner face, being exposed to floating logs, is laid double. Vertical part of whole length of dam, including abutments and wing, protected by 1 and 2-in. sheet-piling, imbedded in 3 ft. of concrete in trench. Inner slope protected by filling of brush and stone extending from settling pond at north abutment across bases of tumbling way and south abutment and around end of latter to gate of sluiceway; this is carried up half vertical height of tumbling way, then horizontally up-stream 9-ft., then slopes 3 to 1 to bed of stream. A level platform, or apron, of logs extends 11 ft. 10 ins. down-stream from outer side of dam.

North Abutment and Gate Chamber: 20¼ ft. on length of dam, 41 ft. 2 ins. wide, 133¾ high. In center of abutment 4 cribs were omitted, leaving space for gate-chamber, which was floored and lined with double 2-in. planking, leaving space 10 ft. 6 ins. x 7 ft. 10 ins. This is divided into two equal compartments, between which are two fish-screens, outer, No. 12 copper wire, 1-in. meshes; inner, No. 15 copper wire, 6 meshes to 1 in.; wooden influent conduit loads from chamber to small "settling pond." Conduit can be shut off by gate, and has 4-in. grating at outer end. Two beveled 22-in. riveted steel pipes lead from gate-chamber extending through dam, one connecting with supply main, other for connection with duplicate main, if ever laid. "Settling pond" is triangular, with base against dam at end of conduit; triangle has 15½ ft. base, is 16 ft. from base to apex, 14 ft. 2 ins. deep; of timber, bolted with cross-ties near apex, small triangular space thus formed filled with stone to load whole structure. Pipe outlet is protected by extending crib down-stream from abutment, 138 ft. long, 15¼ ft. wide, 10 ft. high on river, 6 on other side. To prevent water from tumbling way flooding or undermining pipe outlet "lean-to" is constructed diagonally across corner between tumbling way and above-mentioned crib, consisting of timbers planked to form slope.

South Abutment: 43¾ ft. long, 41 ft. 2 ins. wide, 133¾ ft. high. Near center is sluiceway 14 ft. wide, extending down stream to total length of 73 ft. Both side walls and floor of sluiceway formed by 3-in. planking. Sluiceway closed by stop-log gate, consisting of 17 12 x 12-in. logs, or timbers, 17⅛ ft long, fitting into vertical grooves in abutments, and supported at middle by two 12x12-in. uprights, back to back, on down-stream side. Provision is made for attaching chains to logs and raising same by windlass. Continued from abutment is a "lean-to" extending out 31 ft. to end of sluiceway, to prevent scouring by water discharged over tumbling way seeking original channel. "Lean-to" of stone-filled cribs, stepped from sluiceway. Scour under "lean-to" took place during freshet one year after completion of dam, and was repaired by filling in with concrete.

North Wing: 155 ft. long, 10 ft. wide, 16 ft. 11 ins. high for 20 ft., 7¾ ft. for 135 ft.; at shore-end inner face is protected with gravel embankment for 57 ft. This wing extends over land not generally flooded.

Conduit.—Is about 7¾ miles long, in 5 sections as follows: First, 22 ins. in diam. for 2½ miles; second, tunnel, 6 x 4 ft., 280 ft. long; third, 16 ins. in diam., 4 miles, extending to Burrard inlet; fourth, 12 ins. in diam. for 1,086 ft., across Burrard inlet; fifth, 16 ins., one mile long, extending to Coal harbor, the corporate limits of city. The 22 and 16-in. pipes are of 11-100-in. mild steel plates, riveted, in 23 ft. lengths, and weigh 736 and 552 lbs. respectively. They are warranted to have tensile strength of 72,000 lbs. per sq. in. Joints are of Smith & Moore pattern—that is, band of steel 6 ins. wide and ¼ in. thick encircles the junction of two lengths, space between band and pipe being filled up with lead and well caulked. Play between band and pipe is sufficient to admit of angle of 2°. Large angles are turned by means of special bands and castings. Each length is coated inside and out with asphaltum and coal tar. Considerable difficulty was experienced in laying the 12-in. section across Burrard's inlet, and the Contr., J. F. Ward, Jersey City, officially abandoned the work after hauling out 18 of the 105 pipe-lengths. Arrangements were then made with H. F. Keefer and D. McGillivray, Vancouver, who withdrew the 18 lengths of submerged pipe, then dug trench on shore 3 x 4 ft., x 1,200 ft. long, laid continuous runners of barked firs upon its bottom, and placed and jointed continuously the 105 pipe lengths thereon. The Ward flexible joint was used. Each length was provided with w. i. ring encircling pipes, to which buoys of 500 lbs. buoyancy were attached. Thirteen of original 105 lengths were found defective when tested to 300 lbs. pressure, and were removed, thus leaving 92 lengths in line. To end nearest water was attached large raft of cedar logs capable of floating that end when immersed. Hauling gear consisted of 4 engines, two on each shore, with combined hauling cap. of 105 H. P. To each of 3 of these engines was attached a steel cable, 1¼ ins. in diam., while fourth connected with a 9-in. manila cable. One cable was placed at each end, one in the center and one midway between center and the end nearest the shore. With aid of this machinery, pipe was successfully launched in 9 hours. A complete and interesting description of this work, in detail, will be found in *Eng. News*, Vol. XXI., p. 91. Also see Reference below.

Distribution.—*Mains*, riveted, mild steel, 26¼ miles. *Services*, c. i., galv. i. *Taps*, 500. *Meters*, Worthington, 22. *Hydrants*, from Albion Iron Works, Ltd., Victoria, 75.

Consumption, 2,000,000 galls.: *Pressure*, not given.

Financial.—Cost, $250,000. Cap. stock, $250,000. No debt. Ann. op. exp., $6,000. Ann rev.: consumers, $17,000; city, $5,000. Hydrant rental, $50.

Management.—Prest., John Irving. Secy., J. W. McFarland. Supt., Jno. J. Wickson.

Reference.—"Vancouver Water-Works." By Henry B. Smith, Asst. Engr. Prepared to be read before Can. Soc. of Civil Engrs., Dec. 5, '89. This is an exhaustive description of the works and the difficulties overcome in their construction. Illustrations accompany paper, showing general plans and details of all interesting features.

VICTORIA, *Victoria District.* (Pop., est., 12,000.) Engaged in lumbering and coal mining. Incorp. No sewers. Has electric lights.

History.—Built in or prior to '71 by city. Des. Engr., Thos. A. Bulkely. Improvements and extensions made in '88-9.

Water Supply.—Creek, by gravity from impounding reservoir on stream, for lower levels of city; and by pumping 5 hours per day for higher parts of city. Drainage area, est. by Des. Engr., 2,616 acres. Rainfall, 24 ins.

Dam and Reservoirs.—Masonry dam built in '74 raised water from 183 to 192 ft. above high water in Victoria harbor, making area of Elk lake 394, Bear lake, 18 acres, and flooding swamp between, giving total storage area of 589 acres.

Conduits.—*Old:* 12-in. c. i., 27,066 ft. long. *New:* 16-in. steel, 27,200 ft. long; it was hoped that water would be through it by July 1, '89.

Distribution.—*Mains*, 12 to 4-in. c. i., 15 miles; from R. D. Wood & Co., Philadelphia, Pa. *Services*, not given. *Taps*, 1,738. *Meters*, Worthington, 29. *Hydrants*, from Albion Iron Works, 59. *Close of '80:* Mains, est., 10 miles. Meters, none. Hydrants, "very few."

Financial.—Cost, $261,316. Debt, $257,500: $142,500 at 7, $20,000 at 8, $95,000 at 5%. Sinking fund, $69,540. Ann. op. exp (in '87), est., $8,630. Ann. rev.: consumers, $43,799. Cost, close of '80, est., $200,000. Rev., '80, $20,093.

Management.—Water Comr., Peter Summerfield.

Water-Works Projected with Fair Prospects of Construction.

NEW WESTMINSTER, *New Westminster District.* (Pop., est., 12,000.) On Frazer river, 15 miles from its mouth.

Proposed Works.—In '86 Coquitlam Water-Works Co., Ltd., was incorp. to supply New Westminster, Port Moody and English Bay. Middle of '89 city voted to buy franchise and rights of Co. for $20,000, and to issue $200,000 of bonds for works. E. A. Wilmot and Arthur E. Hill were appointed as Des. Engrs. Eventually each submitted an independent plan; not reported which plan was accepted. Unofficially reported early in '89 that Mr. Hill was Engr., W. H. Keary, Chn. Com. Bids for pipe were to be opened Feb. 15.

Family and Meter Water Rates in Various Cities of the United States and Canada, together with Cost of Works per Family.

INTRODUCTORY.

In compiling these tables a wide difference in rating the various fixture has been found to exist in the several cities and villages. There has generally been, however, sufficient data to enable one to embody figures admitting of fair comparison. In a few cases estimates have been necessary; but these have been indicated, and no more than two estimates have been included in any total. Foot notes have been used when very desirable, but it has seemed best to limit their number, since, if a start had been made to give more than a very few, so many would have been necessary that the pages would have been encumbered.

The more specific explanations not embodied in the foot notes can best be given for each fixture separately.

Family Rates.—These are based on a family of five in a 7- or 8-room house, generally the latter. Where the front width, number of stories, superficial area, assessed valuation or rental value of the dwelling determine the rates, such figures were selected as seemed best suited for comparison with other cities. Oftentimes no distinction is made in the rates for a small or large family or house, and it is but seldom that any of the other qualifications named effect the rates charged. The use of water for all ordinary domestic purposes is allowed under this rate, especially water for kitchen use, and such water as is generally carried by hand about the house. Now and then an extra charge is made for set wash-tubs, and quite commonly but one faucet is allowed. The rates tabulated always include hot and cold water. Those examining this column should at the same time look at the one headed wash bowls, as it is often the case that no charge is made for extra faucets, including those for set wash bowls. A high family rate may sometimes be accounted for by an absence of charge for extra faucets or wash bowls.

Pan Closet.—This type was taken because a lower rate generally prevails for it than for any other, and because more of them are probably in use.

Bath Tubs.—The rate given always includes the privilege of using both hot and cold water.

Wash Bowls.—The same may be said as of bath tubs. See latter part of family-rate paragraph.

Horse and Carriage with use of Hose.—When the schedules make no mention of a higher rate for carriage washing, with or without hose, it is assumed that no extra charge is made.

Cow.—Of course it is understood that in cities or towns of considerable size but few horses or cows are kept, but nearly all schedules give rates for both. A few estimates have been necessary, but these are all indicated.

Hose.—Perhaps the widest variations occur in the hose rates, some towns and cities having a charge including hose for lawn and street sprinkling and sidewalk washing, and others having a separate rate for each. In general, the figures included are for lawn sprinkling. Where the size of the lawn regulates the price, it has been assumed that this would restrict the use of hose for this purpose, and thus the figures are often based on small lawns, ranging from 1,000 to 2,000 sq. ft.

Total per Family.—In a very few cases the schedules state that a reduction will be made if several fixtures are used, but this is uncommon. Allowance has been made for such reduction, either in the separate items or by making the figures in the total column less than the actual sum of those in the other columns.

Total Cost per Family.—This column has been inserted in order to afford some means of judging of the reasons, if any, for variations in water charges. It should be borne in mind that far from every family, except in the largest cities, are water takers; also in comparing total cost per family, it should be remembered that comparatively few families use water for all the purposes named.

Range of Meter Charges.—In some towns there are no prices between those named in these tables, but generally there are from one to three or four, and now and then as many as ten intermediate prices. There is a wide difference in the number of gallons upon which the maximum and the minimum charges are based in the various municipalities. Sometimes the maximum price is for a consumption of 50 galls. a day and again for several thousand gallons.

City.	Present population.	Family rate.	Pan closet.	Bath tub.	Wash bowl.	Horse and carriage, with use of hose.	Cow.	Hose.	Total for family.	Cost of works per family.	Range of meter charges per 1,000 galls., in cents.
MAINE.											
Auburn	10,000	8	4	4	1	3	2	3	*25	125	
Augusta	11,000	8	5	5	0	*8	1.5	3	*30.5	(125)	
Belfast	6,000	6	4[1]	4[1]	2	11[2]	1	2[2]	*30	137.5	25–16
Brewer	3,200	5	3	3	1	5	2	3	*22	78.1	
Brunswick	6,000	8	6	5	0	5	2	5	*25[3]	100	
Fryeburgh	1,600	9	3	3	0	3	1	2	*21	62.5	
Gardiner & R.	6,000	7	5	5	3	5	3	5	*33	(157.1)	
Hallowell	3,500	9	6	5	0	8[2]	1.5	(3)	*32.5	30	
Houlton	4,000	10	5	4	0	6	0	5	*25[3]	68.5	
Lewiston	23,500	5	1.5	2	0	2	1	2	13.5	119.9	22½–2½
Portland	40,000	12	6	5	0	8	0	5	*36	(312.5)	
Richmond	2,800	8	5	5	0	5	3	5	*31	(178.6)	
Rockland, C. & T.	15,200	6	5	3	0	3	1.5	0	*18.5	197.4	
Skowhegan	5,000	6	6	6	4	6	0	5	*25[3]	116	
Springvale[4]	1,300	8	3	(3)	0	5	2	3	*24	38.5	
Waterville & F.	12,000	7	5	5	3	5	3	5	*33	62.5	
Av. of all works	9,400	7.63	4.53	4.19	0.87	5.5	1.53	3.5	25.87	167.3	23¾–9¼
Av. of Pub. "	23,500	5	1.5	2	0	2	1	2	13.5	119.9	22½–2½
Av. of Priv. "	8,460	7.8	4.73	4.53	0 93	5.75	1.57	3.5	26.73	181 3	25–16
NEW HAMPSHIRE.											
Bristol	1,200	6	5	3	0	5	1	4	*24	92.8	
Concord	15,000	5	3	3	0.5	1	1	4.5	18	129.2	25-13½
Dover	14,000	6	5	5	2	8	2	5	*33	91.6	30–20
Exeter	4,000	6	5	5	2	9	1	6	*34	185.0	25–16
Gorham	1,600	10	5	5	0	10	0	5	*35	69.6	
Great Falls	6,000	7	5	5	1	7	2	5	*32	104.2	30–15
Hanover	1,000	7[5]*								60.0	
Hillsb'g'h Brdg.	2,000	8	4	4	0	8	1	5	*30	125.0	
Keene	8,000	5.5	4	4	1	2.5	1.25	4	24.25	139.7	
Lebanon	3,000	5	2	3	1	5	0.5	2	18.5	75.3	
Lisbon	1,200	5	2.5	2.5	1	2	1	3	*17	104.2	20–20
Manchester	41,000	5	2.5	2.5	1	4	1	2	18	101.4	20–20
Milford	3,000	6	5	5	2	10	2	5	*35	.....	45–30
Nashua	18,000	8	2	2	0	4	2	4	*22	77.7	30–15
N. Conway	900	10	5	5	0	3	1	2	*26	111 1	11½ sp.
Pittsfield	2,000	6	2.5	2.5	1	3	1	4.5	*20.5	82.5	
Plymouth	2,000	8	4	3	0	3	0.5	5	*23.5	100.0	
Rochester	5,000	6	2.5[6]	2.5[6]	0.5	5	1	5	*22.5	96.0	30–15
Tilton and N'fd.	3,600	6	2	3	0.5	4	1	4	*20.5	50.0	
Wolfboro	3,000	6	3	3	0.5	5	1	5	23.5	75.0	30–18
Woodsville	800	8	3	2	0	2	2	4	*21[7]	182.6	
Av. of all wks.	6,348	6.64	3.6	3.5	0.7	5.03	1.16	4 2	24.9	107.4	27–18.3
Av. of pub. wks.	12,167	6.7	2 41	3.1	0.8	3.5	0.95	3 5	20 4	106.4	25–10.5
Av. of priv. wks.	4,020	7.07	4.1	3.63	0.66	5.53	1.23	4.43	26.4	123.8	27.7–20.6
VERMONT.											
Barre	5,000	6	4	3	1	3	1.5	5	*23.5	75	
Bennington	5,000	6	3	3	2	5	2	5	*25m	60	
Brattleboro	6,500	10	5	3	0.5	2	2	8	*25.5m	83.3	
Burlington	14,000	7	4	4	1	4	1.5	3	24.5	115.9	40–13⅓
Fair Haven	3,000	5	4	2.5	0	2	1	3	20.5	60	
Hyde Park	500	6	5	5	2	10	2	5	*35	35	
Montpelier	3,200	*8								62.5	
Northfield	2,000	*8								25	
Rutland	10,000	5	5	(4)	0	1.5	1	3	19.5	50	
St. Albans	7,500	6	3	3	1	2	1	3	19	116.6	
St. Johnsbury	6,000	5	2	(2)	0	1.5	1	1.5	13	66.6	
Springfield	3,300	*6[8]								3	
Swanton	3,000	6	4	3	1	2	1	4	21	33.3	40–sp.
Woodstock	1,500	6	4	3	1	3	1	3	*20m	126.6	
Av. of all works.	5,000	6.43	3.9	3.23	0.87	3.27	1.36	3.95	22.4	76.00	40–13⅓
Av. of pub. w'ks.	7,250	6.66	3.5	3.08	0.50	2 16	1.16	2.91	19.6	81.00	40–13⅓
Av. of priv. wks.	3,313	6.25	4.4	3.4	1 3	4 6	1.7	5.2	25.8	62.00	

Closet or bath, alone, 5. [2] First hose, 6, second, 2. [3] Allowing 3 for hose; special rate. [4] Butler Spring Water Co. [5] For each 40 galls. per day. [6] Either singly, 3. [7] For three or more uses (faucets) special rates. [8] One pint per minute through "Tyler gauge." m Maximum charge for these services.

( ) Figures in brackets, est. All except meter rates given in dollars. * Owned by a Company; all others Public. s Special rates for amount above this total. sp. indicates that special rates are made.

City.	Present population.	Family rate.	Pan closet.	Bath tub.	Wash bowl.	Horse and carriage, with use of hose.	Cow.	Hose.	Total for family.	Cost of works per family.	Range of meter charges per 1,000 galls., in cents.
MASSACHUSETTS.											
Abington	4,000	6	4	5	2	5	1	6	29	193.6	30-15
Amesbury	9,000	7	5	5	2.5	11	2	6	*38.5	55.6	
Amherst	4,300	8	4	4	0	4	2	5	*27	93	
Arlington	5,000	6	5	5	2	8	2	3	31	310.6	
Ashburnham	2,000	8	3	3	0	5	2	2	*23	15	
Athol	4,800	10	3	3	0	3	1	3	*23	145.8	30
Attleboro'	6,000	6	5	5	2.5	6[9]	2	2[9]	28.5	94.7	40-20
Avon	1,500	6	5	5	2	5	1	5	29	76.7	35-20
Belmont	1,700	6	5	5	2	10	1	5	34	129.8	
Boston	400,000	7	2.5	2.5	0	6	0	5	23[10]	21.1	18.7-12.9
Braintree	4,500	6	5	5	2	7	1	5	*31	20	
Br'gew'r & E. B.	7,000	8	5	5	2	11	2	6	*39	107.1	50-sp.
Brockton	23,000	5	4	4	1.5	4	2	6	26.5	98.5	30-20
Brookline	10,500	3	2.5	2.5	2.5	5	0.5	5	21	382.2	20-20
Cambridge	65,000	5	6	6	2.5	9	2	5	35.5	195.3	
Cheshire	1,500	8	5	3	0	2	1	(3)	22	56.6	
Clinton	10,000	6	4	4	1	4	2	5	26	135	50-15
Cochituate	1,200	6	5	4	2	6[11]	1	5	29	125	
Cohasset	2,300	10	5	5	0	6	1	6	*33	(186.9)	
Concord	3,900	6	5	4	2	6[11]	1	5	29	182.5	30-30
Danvers	8,000	6	5	5	1	5	1	3	26	164.1	
Dedham	6,700	6	5	5	2	10	2	5	*35	123.1	
Fall River	68,000	5	5	5	2.5	8	1	6	32.5	133.4	30-30
Fitchburg	18,000	6	5	5	2	8	2	5	33	178.6	35-5
Franklin	4,500	8	5	5	2	14	1	10	*45	148.8	50-30
Gardner	9,000	10	3	3	0	3	1	5	*25	(111.1)	30-30
Greenfield	5,000	6	2	2	0	1.5	1 5	2	15	155	20-5
Hingham & Hull	5,500	8	4	4	0	5	0 5	5	*26.5	204.5	
Holb'k & R'd'lph	8,500	6	5	5	2	5	2	5	30	54.5	
Holyoke	35,000	5	3	3	0	2	1	3	17	73.4	15
Hopkinton	3,900	6	4	5	3	3	2	4	27	44.8	
Housatonic	1,500	8	4	4	2	7	1	5	*31	201.6	25-sp.
Hudson	4,000	6	5	5	2	4	2	6	30	111.2	30
Hyde Park	10,000	6	5	5	2	10	2	5	*35	100	
Kingston	1,600	6	4	4	2	3	1.5	3	23.5	134.4	
Lawrence	40,000	5	4	3	0	3	1.5	2.5	19	247.9	174-8
Lee	1,500	8	4	4	0	4	2	5	*27	100	
Lenox	700	10	5	5	0	4[11]	1	(3)	*28	185.7	
Lexington	2,800	8	4	4	1	6	2	6	*31	(178.5)	
Lowell	70 000	6	4	3	0	4	2	3	22	(144.4)	20-20
Lynn	51,400	5	3	3	1	5	1	4	22	143.1	20-sp.
Malden	19,000	6	5	5	2	5	2	(3)	28	134.2	25-25
Mansfield	3,000	6	4	4	2	9	2	5	32	101.1	30-20
Marlboro'	12,000	6	5	5	2	4	2	5	29	190.7	50-20
Medford	9,300	5	5	5	0	5	2	3	25	185	40-sp.
Melrose	7,100	6	5	5	2	4	2	5	29	186	
Middleboro'	3,000	6	5	5	2	5	2	5	30	135.5	30-20
Milford	10,000	6	3	3	1	5	1	5	*24	271.3	30-15
Nantucket	3,100	8	4	4	0	6	2	4	*28	(161.3)	25-20
Natick	8,500	6	6	3	1	2	1	5	24	137.6	
New Bedford	38,000	2.5	2.5	2.5	1.25	4.5	0.5	2.5	16.25	178.3	15-25
Newton	22,500	6			2				(?)[12]	26.6	35-12
No. Adams	15,000	8	3	3	0	2	1	1.5	18.5	(100)	15-10
Northampton	14,000	5	2	2	0	2	1	3	15	95.5	15-6
No. Attleboro'	7,000	6	5	5	2	10	2	5	35	100.7	25-sp.
Northboro'	2,000	6	5	5	2	5	2	5	30	170.3	
No. Easton	2,500	6	5	5	2	5	2	5	30	156	30-20
Norwood	4,000	6	5	5	2	10	2	5	35	137.5	25-20
Orange	3,700	7	5	5	2	8	2	6	*35	135.0	50-sp.
Palmer	2,000	8	4	3	0	4	1	5	*25	100	
Peabody	10,000	5	4	4	0	7	1.5	3	24.5	146.2	
Pittsfield	15,000	3.75	1.87	1.25	0	2.5	0.94	6.25	16.6	80.8	25
Plymouth	7,500	8	3	2	0	3	1	3	20	16.5	
Quincy	13,000	7.5	5	5	2.5	10	2	5	*37	105.8	30-12½
Revere	4,000	6	5	5	2	10	2	5	*35	375	
Riverside	1,000	8				2	1			25	
Rockland	5,000	6	4	5	2	5	1	6	29	150	30-15

[9] Hose rates est.; 1 added to rate for horse and carriage. [10] These rates reduced 7%, Jan. 1, '90. [11] Allowing 2 for hose, special rates. [12] Other fixtures at meter rates.

( ) Figures in brackets, est. All except meter rates given in dollars. * Owned by a Company; all others Public. sp. indicates that special rates are made.

City.	Present population.	Family rate.	Pan closet.	Bath tub.	Wash bowl.	Horse and carriage, with use of hose.	Cow.	Hose.	Total for family.	Cost of works per family.	Range of meter charges per 1,000 galls., in cents.
MASSACHUSETTS--Continued.											
Salem	28,000	3.5	5	5	0	3	1	0	17.5	258.9	20-sp.
Sharon	1,400	7	5	5	2.5	10	2	5	*36.5	185.7	40-23
Shelburne F's	1,800	*[13]								13.8	
So. Framingham	5,500	7.5	[14]	5	2.5	10	2	5	*37	227.2	40-16.7
Spencer	9,000	8	4	4	0	3	2	5	*26	133.3	
Springfield	40,000	8	4	4	0	4	2	5	27	168.7	30-10
Stockbridge	2,100	10	4	4	0	2	1	3	*24	42.8	
Sunderland	300	*7								36.6	
Swampscott[15]	2,500	6	5	5	2	10	1.5	5	*34 5	200	25-sp.
Taunton	25,000	5	5	3	2	9	1.5	5	30.5	111.6	25-9
Turner's Falls	4,000	8	5	5	2	5	2	5	32	131.1	
Uxbridge	3,000	6	5	5	1.5	10	1	6	*30m	43.3	30-30
Vineyard Haven	1,500	8	4	5	2	6	2	4	*31	166.6	
Waltham	16,000	6	5	5	2	3	1	6	28	128.7	30-30
Ware	7,800	6	5	5	2	6	1.5	5	30.5	54.1	30-9
Watertown	7,000	6	5	5	2	10	1	5	*34	164.3	
Whitman	4,000	6	4	5	2	4	2	6	29	103	30-20
Woburn	12,800	6	5	5	2	8	2	3	31	222.3	20-12.5
Worcester	79,500	6	4	5	0	3	1	5	24	125.6	25-15
Av. of all works.	16,810	6.46	4.35	4.25	1.32	5.76	1.51	4.54	27.09	106.34	29.33-17.6
Av. of pub. "	23,928	6.07	4.27	4.11	1.34	5.09	1.48	4.37	24.74	107.04	27.39-16.3
Av. of priv. "	5,597	7.15	4.46	4.5	1.31	6.9	1.55	5.0	31.16	101.42	35. -22.2
RHODE ISLAND.											
Drownville	400	10	5	5	2	9	1	5	*37	100	30-30
E. Greenwich	5,000	8	5	5	2	11	2	6	*39	100	40-sp.
Pawtucket	40,000	5			2.5	10	1	6	24.5[16]	184.7	30-6
Phenix	10,000	6	5	5	2	9	1	5	*33	50	30-30
Providence	125,000	6	5	5	2	9[17]	1	5	33	232.4	30 15
Wakefield	3,000	9	6	6	3	8	2	10	*44	275	50-30
Westerly	9,000	7	5	5	2.5	10[18]	1.5	6	*37	77.7	30-15
Woonsocket	20,000	6			2.5				(?)[19]	92 2	30-10
Av. of all works.	26,550	7.12	5.16	5.16	2.3	9.43	1.3	6.14	35.36	187.61	33.75-18.
Av. of pub. "	82,500	5.5	5	5	2.3	9.5	1	5.5	28.85	223.9	30-10.5
Av. of priv. "	4,566	8	5.2	5.2	2.3	9.4	1.5	6.4	38	193.61	36-26.2
CONNECTICUT.											
Ansonia	8,000	5	3	3	0	7[20]	1	5	*24	81.2	
Bethel	3,000	5	3	3	0	5[21]	1	3	20	50	30-20
Bridgeport	45,000	5	4	6	0	6	(2)	4.5	*27.5	88.8	30-5
Bristol	4,000	6	3	3	0	3	1	4	*20	137.5	
Canaan	600	6	3	3	0	6	1	4	*23	66.6	
Danielsonville	4,000	6	5	5	0	9	1	6	*22	150	25-10
Hartford	48,000	5	3	1	0	2	1	3	15	181	30-7½
Kent	300	6	3	3	0	6	1	4	*23	258.3	
Middletown	10,000	5	3	2	0	2	1	3	16	123.7	30-10
Naugatuck	6,000	6	3	3	0	3	1	4	*20	69.2	20-15
New Britain	20,000	5	3.5	3.5	0.5	6.5	1	3.5	23.5	67.5	10
New Haven	80,000	6	3	3	0	6	1	3	*22	98.5	30-15
New London	13,000	5	2	2	0	2	2	5	18	131.5	26.6-9
New Milford	1,500	6	3	3	0	2	1	4	*19	159	
Norwalk	7,000	5	3	3	0	5	1	3	20	185.7	30-20
Norwich	18,000	5	3	3	0	5	1.5	2	19.5	141.6	30-15
Plainville	2,000	5	3	3	0	9	1	6	*27	75.8	
Portland	4,200	6	5	5	2	9	1	6	*34	20.3	25-13
Putnam	6,000	6	4[22]	4[22]	2	8	1	5	*30	125	20-10
Sharon	2,600	10	4	4	0	7.5	1.5	5	*32	27.9	
Southington	6,000	6	3	2	0	2	1	3	*17	77.5	20-15
Stafford Springs	3,000	6	3	3	1	4	1	5	*23	125	30-6
Stamford	16,000	6	5	5	0	6	1	5	*28	104.1	30-20
Stonington and Groton	3,600	6	4[23]	4[23]	2	9	1	6	*32	333.3	25-16

[13] For ½ pint per minute; 8 for 1 pint: 15 for 1 quart; 28 for 2 quarts. [14] No pan closets allowed. [15] Marblehead Water Co. [16] No rate specified for bath or water closet. [17] Allowing 5 for hose. [18] Allowing 6 for hose. [19] Nearly all taps metered. [20] Allowing 5 for hose. [21] Allowing 3 for hose. [22] If bath tub or water closet alone, 5. [23] 5 for either alone.

( ) Figures in brackets, est. All except meter rates given in dollars. * Owned by a Company; all others Public. m Maximum charge for these services. sp. indicates that special rates are made.

City.	Present population.	Family rate.	Pan closet.	Bath tub.	Wash bowl.	Horse and carriage, with use of hose.	Cow.	Hose.	Total for family.	Cost of works per family.	Range of meter charges per 1,000 galls., in cents.
CONNECTICUT--Continued.											
Thomaston	4,000	6	3	3	0	6	1	4	*23	52.5	
Thompsonville	4,000	8	5	5	0	4	1	5	*28	75	35-15
Torrington	3,900	6	3	3	0	6	1	4	*23	67.3	
Waterbury	30,000	5	3	2	0	2	1	3	16	82.2	30-sp.
Willimantic	10,000	6	3	3	1	4	1	2	20	118.5	30-6
Winsted	6,000	5	2		0	2				107.2	
Av. of all works	13,250	5.8	3.35	3.29	.25	5 13	1.06	4.14	23.62	92 23	27. -12.64
Av. of pub. "	16,500	5.1	2.85	2.5	.15	3.5	1.05	3.05	18.66	93.82	27.4-13.6
Av. of priv. "	11,625	6.05	3.6	3.84	.30	5.95	1.08	4.62	25.87	87.55	26.36-12.72
NEW YORK.											
Albany	91,000	18	2			3		8	31[24]	(106.4)	
Albion	5,200	5	4	3	2	3	1	6	*24	115.3	30-10
Amsterdam	17,000	6	1	1	1	2	1	2.5	14.5	97.7	30-6
Andes	500	*10								72	
Attica	3,000	5	3	3	0	5	0	6	*22	126.6	
Auburn	26,000	5	4	4	0	4	0	4	*21	96.2	40-5
Bainbridge	1,000	8	5	5	0	3	(1)	5	*27	100	
Ballston Spa	4,500	6	3	3	0	3	1	2	18	111.1	
Bath	5,000	5	4	3	0.75	3	2	6	*23.75	100	30-10
Binghamton	30,000	5	5	5	1	4	(1)	3	24	78.5	25-6
Brooklyn	770,000	8	0	0	0	2.5	0.75	4.5	15.75	88.9	10-10
Buffalo	250,000	7.2	3	3	0	4.2	0.9	(4)	22.3	96.5	6[25]-3
Cambridge	1,800	8	4	3	2	4	2	8	*31	111.1	50-8
Camden	2,500	5	2	1.5	0.5	2	(1)	2	14	72.2	20-7½
Canisteo	3,000	5	4	3	0 75	3	1.5	6	*23.25	75	30-10
Castile	1,200	8	5	5	2.5	4	1.25	6	*31.75	70	1½-20
Clinton	2,000	5	2	3	2	5	0	2	19	90	50-10
Cobleskill	1,600	5	3	3	0	5	1	5	22	203.1	15-8
Cohoes	21,000	5.5	3	2	0	2	2	3	17.5	65.5	
College Pt.	5,000	10	2	3	0	4.5	1	(4)	24.5	213	20-12
Corning	7,000	8	4	4	3	8	2	8	*37[26]	535.7	50-20
Delhi	1,500	*10								83.3	
Deposit	1,800	6	2.5[27]	2.5[27]	0	6	2	3	*22	83.4	
Dunkirk	10,000	5	2	2	0	1	0.5	4	14.5	75	
Elmira	27,000	8	4	4	4	8	0	8	*36	105.5	50-10
Fishkill & Mat.	15,000	6	4	5	2	2.5	2.5	4	*26	(50)	
Flatbush	10,000	9	4	4	1	10	2	10	*40	(162.5)	
Fonda	1,200	4	2	2	1	1	1	2	13	108.3	30-9
Fredonia	3,500	4	2	2	0.5	3.5	1	3	16	128.5	
Fulton	4,500	6	5	4	1	3	2	6	*27	144.4	25-9
Fultonville	1,700	7	3	3	0	3	1	5	*22	58.8	60-40
Geneseo	2,300	6	5	5	0	4	1	3	24	145.7	30-30
Geneva	7,500	9	5	5	1.5	5	2	5	*32.5	80	
Glens Falls	8,000	5	4	3	0	2	2	6	22	82 5	
Gouverneur	3,200	10	3	3	0	3	0	5	*24	62.5	
Gowanda	2,000	9	3	2	0	3	2	5	*24	57.3	
Herkimer	4,000	4	3	3	1	5	0.5	2.5	19	62.5	
Hoosick Falls	7,000	6	6	6	3	5	2	10	*38	(82.1)	50-sp.
Ithaca	12,000	8	5	5	2	8	(2)	6	*36	93 3	50-20
Johnstown	8,000	4	2	2.5	0	2	1	2	13.5	77.6	20-15
Keeseville	3,500	6	3	3	1	3	1	2	19	76	
Kingston	23,000	6	4	5	2	8	2	6	*33	130.4	30-8
Lansingburgh	9,000	5	4	3	0	2	1	10	25	88.8	20-20
Little Falls	10,000	3	2	2.5	1	1.5	0.5	2.5	13	152.5	30-30
Malone	5,000	*13	3	2	1					140	
Mamaroneck	2,000	8	5	5	0	6	2	4	*30	162.5	30-30
Middletown	9,000	5	2	2	0	2	(1)	(6)	18	109.3	20-16.8
Mt. Morris	2,500	8	5	4.5	2.5	4	1.25	5	*30.25	120	150-20
Mt. Vernon	11,000	10	5	5	3	7.5	2.5	5	*38	238.6	sp.-sp.
Newark	5,000	6	3.5	3	1	3	2	6	*24.5	120	25-sp.
New Brighton & P. R.	21,000	8	5	5	1	11	2	10	*42	89.3	50-sp.
Newburgh	20,000	10	0	0	0	2	1	3.5	16.5	131	
N. Y. City	1,700,000	8	0	0	0	6[28]	1	0[28]	15	178.2	50-20

[24]Purposes not specified probably free, except for cow: rates doubled in '89 to meet expense of new works. [25]Elevators only. [26]Leased from village. [27]Either alone, 3. [28]Hose not allowed.

( ) Figures in brackets, est. All except meter rates given in dollars. * Owned by a Company; all others Public. sp. indicates that special meter rates are made.

City,	Present population.	Family rate.	Pan closet.	Bath tub.	Wash bowl.	Horse and carriage, with use of hose.	Cow.	Hose.	Total for family.	Cost of works per family.	Range of meter charges per 1,000 galls., in cents.
NEW YORK--Continued.											
No. Tarrytown.	3,000	7	5	5	2	5	2	10	*36	66.6	50-sp.
Nunda	1,200	8	5	5	2.5	4	1.25	6	*31.75	104.2	150-20
Nyack	6,500	12	3	3	0	10	0[29]	5	*33	138.5	
Ogdensburgh	11,000	7	2.5[30]	2.5[30]	0	5	0[31]	3	20	61.4	
Olean	9,000	5	2	3	1			3	14	473.6	
Oneonta	8,000	6	5	5	0	11	0[31]	5	*32	125	50-20
Oswego	24,000	10	5	3	0	3	1.5	6	*28.5	108.6	40-6
Owego	6,000	7	5	4	0	3	(1)	6	*26	136	
Peekskill	7,000	6[32]	2	2	0	4	1	5	20	109.3	13.3-13.3
Phœnix	2,500	5	0	0	0	5	0[31]	5	*15	160	20-5
Plattsburgh	7,000	14	3	3	0	5	0[31]	3	28	128.1	
Potsdam	3,800	6	2.5[30]	2.5[30]	0	3	0[31]	6	20	65.8	
Poughkeepsie	22,000	3.5	2	1.5	0.75	4	1	7.5	20.25	132.9	17.3-13.3
Richf'd Sp'gs	3,000	5	5	2.5	0	5	1	5	*23.5	50	
Rochester	130,000	5.5	2	3	0	6	1	4	21.5	153.7	13-5
Rome	14,000	6	3	3	0	6	1	3	22	57.1	
Round Lake	1,500	3	2	3	2	5	(1)	4	*20	23.3	
St. Johnsv'e	1,200	3	2	1.5	1	sp.	sp.	sp.		20.8	
Salamanca	4,500	10[33]	3	3	2	5	(2)	7	*32	38.8	
Sandy Hill	3,000	7.5	4	5	0	4	1.5	4	*26	80	50-sp.
Saugerties	6,000	6	4	5	3	8	2	6	*34	145.8	50-8
Schenectady	20,000	4	1.5	1.5	0	1	0.5	5	13.5	32.9	
Seneca Falls	8,000	8	5	5	2	12	(1)	6	*39	(93.8)	
Sherburne	1,000	5[33]	3	4	2	2	2	5	23	185	50-10
Sing Sing	7,000	7	3	3	0.75	2	1	6	22	107.1	17.3-13
Suspension B'ge.	3,000	5	5	3	(2)	7	1	4	27	26.6	10[34]-10[34]
Syracuse	83,000	10	5	4	0	3	(1.5)	6	*29.5	51.8	25-6
Ticonderoga	2,000	10	3	3	0	3	1	5	*25	50	
Tonawanda	5,000	7	3	2	0.5	2	1	5	20.5	180	25-10 to 3
Troy	60,000	5	3	2	0	5	1	3	19	97.6	
Unadilla	1,500	8	5	5	(2)	8	3	5	*36	(5.0)	sp-sp.
Utica	45,000	9	6	5	0	6	1.5	8	*35.5	87.7	30-7.5
Warsaw	3,000	5	3	3	2	4	2	6	*25	66.6	25-10
Warwick	1,300	5	2	2	0	2	1	4	16	96.2	
Watertown	15,000	8	4	3	0	1	1	4	21	100	15-sp.
Waterville	3,000	5	2	3	2	4	1	2	19	60	49-sp.
White Plains	4,500	7	2.5	3.5	0	3	1.5	5	*22.5	133.3	50-15
Whitesboro	1,800	*7.5	5	5	5					9.8	
Whitesville	1,000	5	2.5	(2.5)	(2.5)	5	0[31]	2	*19.5	17.5	
Worcester	1,500	8	5	5	2	10	0[3]	4	*24	113.3	
Yonkers	26,000	8[35]	....	....	....	....	....	....	....	165.7	40-16[35]
Av. of all works.	31,835	6.9	3.35	3.23	.87	4.44	1.14	4.92	24.74	150.39	39-13.29
Av. of pub. "	69,914	6.1	2.50	2.63	.61	3.31	.86	3.85	19.43	112.33	33.4-12.9
Av. of pri "	5,125	7.53	3.96	3.71	1.15	5.36	1.37	5.81	29.18	161.52	43.6-13.6
NEW JERSEY.											
Asbury Park	3,500	6	3	2	1	3	1	5	21	131.4	40-40
AtlanticCity[36]	8,000	11	3	4	3	3	2	5	*31	(312.5)	35-25
Bayonne[37]	18,000	10[38]								37.5	20-13.3
Bound Brook	1,500	8	5	5	1	2	(1)	5	*27	116.6	sp.-sp.
ridgeton	11,000	5	2	3	1	2	1	4	18	45.4	
Burlington	8,500	6	4	4	1	3	(1)	(5)	24	53.5	
Camden	70,000	9	2	3	1	2	1	3	21	78.6	18-6
Dover	4,000	7.5	5	5	3	3	3	5	*31.5	75	20-20
East Orange & Bloomfield	16,500	7.5[39]	2.5	5	(2)	3.5	1.5	7	*29	151.5	
Elizabeth	35,000	10	5	5	0	5	2	4	*31	142.9	
Gloucester C'y	5,500	3	2	2	1	2	1	3	14	74.5	41
Hoboken	75,000[40]									124.5	*23.3 15.3
Haddonfield	2,500	8	5	5	0	5	1	5	*29	80	30-15
Jersey City	155,000	11.4	2	3	0	1	1	3	21.4	161.3	14.8-10
Lambertville	5,000	7	5	5	1	1	(1)	6	*20[m]	40	50-20

[29] Included under horse and carriage. [30] Either alone, 3. [31] Included under horse and carriage. [32] Including 1 extra for range boiler. [33] Including 2 extra for range boiler. [34] For manufacturers using 20,000 galls. or more per day. [35] After family rates, charges all on metered fixtures. [36] Atlantic City W. W. Co. [37] Buys water of Jersey City. [38] Meters generally used. [39] Including 1.25 for kitchen boiler and laundry use. [40] This supply includes large outlying territory. [41] All new consumers for several years have been metered.

( ) Figures in brackets, est. All except meter rates given in dollars. * Owned by a Company; all others Public. [m] Maximum charge for these services. sp. indicates that special rates are made.

City.	Present population.	Family rate.	Pan closet.	Bath tub.	Wash bowl.	Horse and carriage, with use of hose.	Cow.	Hose.	Total for family.	Cost of works per family.	Range of meter charges per 1,000 galls., in cents.
NEW JERSEY--Continued.											
Montclair.....	7,500	7.5[39]	2.5	5[39]	2	5	2	5	*29	120	
Moorestown...	2,000	6	2	4	0	2	1	8	*28	100	25-15
Morristown....	8,000	8	6	6	2	11	2	(5)	*[44] [42]	102.5	33⅓-33⅓
Mt. Holly.....	5,000	*6	4	5	2					50	30-15
Newark.....	160,000	7.5[39]	2.5	5	0	2.5	2	4.5	24	79.1(7)	[43]-(7) [3]
N. Brunswick.	20,000	8	5	4	1	7	2	5	32	123.3	50-12.8
Ocean Grove..	1,000	6	0	3	1	2		3	*15	(275)	15-10
Paterson.	65,000	12	0	0	0	8	1	8	*29	(115.4)	
Princeton.....	3,800	*[44] [4]								87.1	60-30
Rahway.....	7,000	6	3	5	0[45]	2	1	6	23	132.1	30-11
Salem	6,000	5	2	3	1	1	1	4	17	68.8	20-15
Short Hills....	400	15	6	6	2	7	2	(5)	*[43] [42]	90	33.3-33.3
Somerville & R.	12,000	10	4	4	0	5	0[49]	4	*27	26.9	20-20
Trenton.....	40,000	6	3	3	1	3	1	3	18	66.3	12-12
Vineland.....	3,300	5	3	3	1	2	1	4	*19	68.2	
Wenonah.....	500	*18						3		100	
Av.of all works	24,532	8.11	3.20	3.96	1.04	3.42	1.34	4.72	25.27	110.52	23.99-18.6
Av. of pub. "	42,042	8.08	2.71	3.50	.83	2.60	1.30	4.04	20.31	103.31	29.48-16.51
Av. of priv. "	13,316	8.14	3.60	4.33	1.20	4.50	1.37	5.27	28.23	124.73	28.49-20.69
PENNSYLVANIA.											
Allegheny.....	80,000	8.75	2	3	1.5	1.5	0.75	5	22.5	120.6	
Allentown.....	25,000	7.5	2.5	2.5	1	6	1	7	27.5	55	25-15
Altoona.....	30,000	4.8	2	3	0.5	2	0.5	5	17.8	61.7	
Beaver F's ...	13,000	10	3	2	0	3	0[46]	3	*21	69.2	
Berwick.....	4,000	7	(4)	4	0	3	(1)	1.5	*20.5	31.3	
Bethlehem	6,000	3	2	2	2	3	0[46]	5	*17	75	
Birdsboro . ..	2,800	5	2	3	0	5	0[46]	3	*18	98.2	21.6-10.6
Bloomsb'gh....	5,000	6	3	3	1	2	0.5	4	*19.5	70	35-10
Bradford.....	11,000	8	3	2	1	2	1.5	5	22.5	52.3	
Bristol.....	7,000	7	3	4	1	(2)	(1)	4	*22	44.7	
Catasauqua. ..	3,500	5	2	3	0	1	0.5	5	*16.5	74 3	
Centralia.....	2,000	6	3	3	0	1	0.5	5	*18.5	25	
Chester.	20,000	8	2	5	2	3.5	1.5	6	*28	600	
Clarion.... ...	1,600	*18	3.6	3.6						78.1	
Conshohocken.	7,000	7	2	3	1	4	0.5	3	*20 5	63.6	
Corry.....	8,000	10	5	5	2	16	2	8	*48	187.5	50-30
Easton.....	15,000	11.5[47]	4	3	1	13	1	6	*29.5	108.3	40-15.6
Emporium	2,000	6	3	4	2	4	0.5	4	*23.5	82.5	
Erie	40,000	5	3	3	1.5	2	0.75	5	19.75	125.8	10-6
Etna.....	2,800	5	4	4	2	8	1	5	*29.5	71.4	30-8
Greensburgh...	5,000	5	5	6	4	5	1.5	10	*36.5	(300)	27-5
Harrisburgh...	43,000	8.2[48]	2	4.1	1.7	4	1	2	23	(116.3)	
Honesdale.....	5,000	6	4	4	3	4.5	0.75	5	*20m	280	
Hummelstown	1,600	5	2	2	1.5	3	0[49]	8	*21.5	75	
Huntington. ..	5,000	7	3.5	4	3	8	1	5	*31.5	75	35-7
Jermyn.....	2,500	8	3	3	1	1	1	3	*20	68	
Jersey Shore..	2,000	11[50]	2	5	1	9	0[49]	8	*36	125	
Johnstown....	30,000	9.75	3	3	1	(4)	(1)	5	*28.75	63.2	
Lancaster.....	32,000	6	3	3	0	4	1	1	18	96.9	
Lansford.....	3,000	9	3	3	0	6	(1)	3	*25	108.3	
Latrobe.....	4,500	5	4	4	2.5	5	0.5	5	*26	122.2	30-30
Lebanon.....	13,000	5	2	3	1	1	0.5	2	14.5	100	
Lewisburg.....	4,000	6	1	3	1	2	0.5	3	*16.5	122 2	
Manheim.....	2,300	5	3	3	1	4	0.5	4	*20.5	60.9	
Mauch Chunk.	5,000	5	2	2	2	(2)	(1)	2	*16	375	
Mercer.....	2,500	5.75	3	4	0 5	3	0.5	5	*21.75	44	
Meshoppen....	800	4	2	(2)	2	4	0[49]	(2)	*16	62.5	
Milton	5,500	5	2	3	1	1.5	1	3	*16 5	45.4	
Minersville....	4,000	5	3.5	2.5	0	1	(1)	3	*16	40	8-8a
M'n'ngahelaCy	4,000	11	5	5	0	5	1	5	*32	78.8	
Mt. Joy.....	2,200	5	3	3	1	2	1	3	18	113.5	15.7-15.7

[39] Including 1.25 for kitchen, boiler and laundry use. [42] It is intended that all new services shall be metered, if more than one fixture. [43] Too complex to classify. [44] Minimum rate entitling to use 1,000,000 galls. per year; all excess at meter rates. [45] Included under bath tub. [47] Including 3 extra for range and sink. [48] Including 1.65 for range. [49] Included under horse and carriage. [50] Include 1 for range. a Large consumers.

( ) Figures in brackets, est. All except meter rates given in dollars. * Owned by a Company; all others Public. m Maximum charge for these services.

City.	Present population.	Family rate.	Pan closet.	Bath tub.	Wash bowl.	Horse and carriage, with use of hose.	Cow.	Hose.	Total for family.	Cost of works per family.	Range of meter charges per 1,000 galls., in cents.
PENNSYLVANIA--Continued.											
Nazareth	1,000	*5				1	1	2		75	
New Bethl'h'm	1,100	*12		12						52.7	
Newtown	1,400	7	4	3	1	1.5	1.5	3	*21	82.2	
Norristown	16,000	7	1	3	0	4	(2)	3	*20	103.1	
No. Wales	1,500	8	4	3	2	4	(2)	5	*28	50	
Oil City	12,000	10	2.4	2.4	1.4	3	0.8	4	22	70.9	30–6
Philadelphia	1,000,000	5	1	3	1	5	0[49]	3	18	75	6–6
Phillipsburgh	3,000	8	2	3	0.5	3	(1)	3	*20.5	66.6	
Pittsburgh	215,000	10	3	4	0	4.5	1.5	6.5	29.5	110.5	20–5
Plymouth	10,000	7.2	4.75	4.75	2.5	1.5	1.5	(?)[51]	*20m	50	
Pottsville	25,000[52]	7.2	6	6	0	3.6	(1)	(4)	*27.8	(550)	8–8
Reading	60,000	5	2	3	0	8.5	0[4]	3	21.5	91.7	21.3–10.6
Renovo	4,500	6								63.3	
Ridgway	2,500	4	1.5	2	0.5	2	0.25	2	12.25	47.7	
Sayre & Ath'ns	6,000	10	4	4	4	8	0[49]	8	*30.4[53]	66.7	50–10
Sewickley	3,500	12	3.5	3.5	0	4	1.5	7	31.5	142.9	
Shamokin	25,000[52]	7	3	3	1	2	0.5	3	*19.5	100	
Sharon	9,000	6	5	5	2	4.5	1.5	5	*29	166.7	
Sharpsburgh	5,000	5	4	4	2.5	8	1	5	29.5	54	30–8
Shickshinny	2,000	6	4	4	2	2	1	2	*21	28	
Slatington	2,500	6.25	2.5	2.5	1.25	1.25	0.62	2.5	16.9	266.3	
Smethport	1,200	15	4	4	0	6	0[49]	5	*34	83.4	
So. Bethlehem	7,000	7.5	2	3	1	5	(1)	3	*22.5	107.1	25–10
So. Easton	6,200	9[54]	4	3	1	3	1	6	*27	32.2	
Sunbury	7,500	8	3	3	1	2	0.5	3	*20.5	44	sp–sp
Tioga	1,000	*12				5	0[49]			100	
Towanda	5,000	7	4.5	4	0	3	1[49]	6	*25.5	80	30–30
Tremont	2,200	12	2	5	0	2	(1)	5	*27	58.9	
Troy	1,500	7.5	2 5	5	1.5	3	1	4	*24.5		20–20
Tunkhannock	2,500	6	3	3	1	2	1	3	*19	60	
Tyrone	4,500	8	3	3	0	(2)	(1)	3	*20	33.3	
Ulyses	600	8	(4)	4	2	10	0[49]	5	*33	5.8	
Union City	3,000	7.5	3	3	1	2	0.75	6	*23.25	11.6	
Washington	7,000	21[55]	5	5	5	3.5	1.5	5	*46	189.4	
Wayne	2,500	10	1.5	4.5	1.5	7.5	0[49]	3	*28	80	
Wellsboro	3,000	10	4	4	4	8	2	6	*38	160	50–20
Wilk's-Barre[56]	40,000	6	4	4	2	2	1	5	*23m		
Willlamsport	28,000	7	2	5	1	5	0[49]	5	*25	91	
York	20,500	6	5	4	1	4	0.5	4	*24.5	48.8	
Av. of all works	25,148	7.46	3.7	3.61	1.1	3.86	.81	4.36	23.91	89.98	27.72–13.4
Av. of pub. "	87,122	6.75	2.71	3.7	.9	3.62	.80	4.06	21.45	85.8	19.75–09.03
Av. of priv. "	7,155	7.66	3.17	3 51	1.16	3.94	.81	4.45	24.63	106.3	31.71–16.09
DELAWARE.											
Dover	4,500	6	5	5	1	3	2	5	27	25.6	30–sp.
Smyrna	3,000	5	2	3	1	1.75	0.5	3.25	16.5	40	20–15
Wilmington	42,500[57]	5	2	3	1	4	0.5	3	18.5	86.4	10–10
Av. of pub. works	16,666	5.33	3	3	1	2.92	1	3.75	20.66	74.7	20–12.50
MARYLAND.											
Baltimore	400,000	12	0	0	0	3	(1)	3	19	140.2	6–6
Easton	4,500	6	3.6	3.6	1.25	2.5	1.25	5	*23.2	44.5	25–20
Havre de Grace	3,500	3.65	1.2	2	0	0.7	0.7	4.5	*16.2	28.6	25–25
Westminster	3,000	7.2	3.6	3.5	0	2.5	1.25	5	*23	41.7	25–25
Av. of all works	102,750	5.71	2.1	2.27	0.31	2.92	1.3	4.38	20.35	137.4	20.35–01.9
Av. of pub. "	400,000	12	0	0	0	3	1	3	19	140.2	6–6
Av. of priv. "	3,666	3.62	2.8	3.03	.41	2.9	1.4	4.83	20.8	38.6	25–23.33
DISTRICT OF COLUMBIA.											
Washington & Georgetown	160,000[57]	5.5	0	0	0	1.5	0.25		7.25	265	3–3

[49] Included under horse and carriage. [51] Not allowed without special permit. [52] Est. pop. supplied. [53] Deducting 20% discount for total rental $30 to $40. [54] Including 3 extra for range and sink. [55] Including 5 extra for hot and cold water or slop sink. [56] Wilkes-Barre W. Co. [57] Pop. in '80.

( ) Figures in brackets, est. All except meter rates given in dollars. * Owned by a Company; all others Public. m Maximum charge for these services. sp. indicates that special meter rates are made.

City.	Present population.	Family rate.	Pan closet.	Bath tub.	Wash bowl.	Horse and carriage, with use of hose.	Cow.	Hog.	Total for family	Cost of works per family.	Range of meter charges per 1,000 galls., in cents.
VIRGINIA.											
Charlottesv'e..	6,000	6.5	3.5	5	0	1	0.5	3	19.5	95.8	
Danville.....	13,000	9	5	5	0	6	(2)	5	32	(61.2)	
Fredericksb'gh	5.000	4	0	0	0					30	
Liberty.....	3,500	5	4	2	0	2.5	(1)	4	18.5	64.3	
Lynchburgh...	25,000	6	3	3	2	4	(1)	5	24	(70)	10-10
Manchester..	8,000	9	3	8	0	2.75	(1)	4.5	*23.25	37.5	15-15
Norfolk.....	30,000	7.5	3	3	0	7.5	(1)	6	28	139.5	40-20
Petersburgh..	25,000	6	5	6	0	5	0	5	27	30.8	
Portsmouth & Suffolk	15.000	7.5	3	3	2	7.5	(0)	6	*29	(75)	30-20
Richmond.....	85,000	5	3	3.5	1.5	2.75	1	4.5	21.25	(88.2)	15-7
Roanoke.....	10,000	9	3	3	1.5	3.5	2	5	*27	128.5	
Salem	2,300	5	1.5	2	0	2.25	1.5	5	17.25	28.3	
Av. of all works.	18,983	6.63	3.08	3.21	.58	4.07	1	4.82	24.25	82.2	22 -14.4
Av. of pub. "	21,644	6	3.11	3.28	.39	3.88	1	4.69	23.41	82.2	21.66-12.33
Av. of priv. "	11,000	8.5	3	3	1.16	4.58	1	5.17	26.42	82.1	22.5 -17.5
WEST VIRGINIA.											
Charleston....	8,000	8	5	5	0	4	1	6	*29	79	50-20
Parkersburgh.	10,000	7.5	2	2	0	3	1	2.75	18.25	53.5	15-6
Wellsburgh....	3,000	5.5	5	2.5	0	2	(1)	7	25	43.3	
Wheeling.....	35,000	5	6	1.25	0	1	(1)	9	23.25	108	15-15
Av. of all works	14,000	6.5	4.5	2.69	0	2.5	1	6.19	23.38	91.6	26.66-13.33
Av. of pub. "	16,000	6	4.33	1.92	0	2	1	6.25	21.5	93	15 -10.5
Av. of priv. "	8,000	8	5	5	0	4	1	6	29	79	50 -20
NORTH CAROLINA.											
Durham.....	8,000	12°	4	4	2	4	12	5.4	*32.6	156.3	25
Greensboro....	3,500	7	3.5	4	2	1.5	(1)	5	*24	107.1	25-25
Raleigh.....	15,000	8	6	5	2	10	1.6	5	*37.6	61.3	40-15
Salisbury.....	5,000	6	4	4	1	3	2	5	*25	100	30-sp.
Wilmington...	23 000	6	4	4	2	5	2	5	*28	42.4	20-sp.
Winston.....	8,000	9.5	5	2	0	1	1	5	*23.5	32.5	50-30
Av. of all works. All private works.	10,416	8 08	4.62	3.83	1.5	4.08	1.47	5.07	28.45	68.5	31.67-2.33
SOUTH CAROLINA.											
Charleston	60,000	12	4	4	1	12	0	6	*39	33.3	60-25
GEORGIA.											
Athens.....	10.000	9.75	6	6	3	10	1.5	5	*41.25	61.5	50-30
Atlanta.....	66,000	(†)[1]								36.7	15-(†) [1]
Augusta.....	46.000	5	1	3	1	1	0.5	5	16.5	(54 3)	
Brunswick ...	6,000	12	4	6	3	3	0	8	*38[2]	80	sp.-sp.
Dalton.....	3,500	7	3	4	0	1	1	10	26	46.7	10-10
Macon.....	28,000	10	3	3	3	3	0	3	*25[3]	51.3	
Rome.....	10,000	8	5	8	0	7.5	0	10	38.5	48	25-15
Av. of all works.	24,213	7.39	3.14	5	1.67	4.25	.5	6	30.88	47.9	25 -18.33
Av. of pub. "	31,250	6.66	3	5	.33	3.17	.5	6.66	27	44 5	16.66-12.5
Av. of priv. "	14,666	10.58	4.33	5	3	5.33	.5	5.33	34 75	57.5	50 -30
FLORIDA.											
Jacksonville...	25,000	12[4]								23.4	16-9¼
Orlando.....	6.000	9	4	6	4	6	2	8	*39	125	35-7
Palatka	5,000	10	5[5]	5[5]	2	4	2	12	*40	140	40-20
Pensacola.....	15.000	8	4	4	4	8	1.5	8	*37.5	50	50-25
Sanford	4,000	12	3	6	0	8	0[6]	(6)	*35	63.8	
Av. of all works.	11,000	10.2								55 3	35.25-15.33
Av. of pub. "	25.000	12								23.4	16 -9¼
Av. of priv. "	7,500	9.75	4	5.25	2.5	4.5	1.38	8.5	37.88	81.8	41.66-17.33

° 3 extra for kitchen boiler. [1] All metered, domestic not given; mfg: 15c. each for 400 M, 14c. each in excess to 500 M. 13, do., 600, on to 7c. each above 1,100 to 1,200 M, and 6c. each M for all in excess of 1,200 M per month. [2] Rebate allowed when "several fixtures" are used. [3] 10 for first opening. 3 for each additional. [4] All water metered; 12 lowest rate. [5] Closet or bath alone, 6. [6] Included under horse and carriage.

( ) Figures in brackets, est. All except meter rates given in dollars. * Owned by a Company; all others Public. sp. indicates that special meter rates ate made.

City.	Present population.	Family rate.	Pan closet.	Bath tub.	Wash bowl.	Horse and carriage, with use of hose.	Cow.	Hose.	Total for family.	Cost of works per family.	Range of meter charges per 1,000 galls., in cents.
ALABAMA.											
Anniston	10,000	15[8]	4	5	1	8	2	10	*45	50	50-50
Bessemer.....	3,500	16	5	6	0	(5)	(1)	5	*38	140	
Decatur	12,000	11[8 1-2]	3	4	2	6	2	5	*33	270.8	24-7
Eufaula.....	5,000	6	6	6	2	3	2	10	*35	60	25-10
Mobile	40,000	15[8]	4	5	1	8	2	10	*45	156.3	50-50
Montgomery..	35,000	12[8 1-2]	10	8	2	4	2	9	*47	99.6	25-25[10]
Selma.....	12,000	9	3	3	2.5	5	0[6]	5	*27.5	70.8	45-8
Av. of all works.	16,786	12	5	5.29	1.5	5 56	1.56	7.71	38.64	128.7	36.5-25
All private works.											
MISSISSIPPI.											
Vicksburgh...	15,000	10	5	5	2	8	2	11	*43	58.3	50-50
LOUISIANA.											
Baton Rouge..	10,000	10	3.5	5	0	3.5	1.5	12.5	*36	37.5	50-15
New Orleans ..	230,000	14	7	7	3	5	1.5	10	*47.5	52.1	40-25
Shreveport....	16,000	7	5	3	0	4	1	9	*29	78.1	30
Av. of all works.	85,333	10.33	5.16	5	1	4.16	1.33	10.5	37.5	53.1	40-20
All private works.											
TENNESSEE.											
Bristol.....	5,000	6	4	4	0	[4	(1)	7.5	*26.5	75	25-25
Chattanooga[11]	40.000	9	(5)	6	0	8[12]	2	6	*36	78.5	25-6
Columbia.....	5,000	18.6[3]	6	9	6	11[12]	6	12	*68.6	(104)	
Dyersburgh....	1,500	7.5	3	3	0	4	1	5	*23.5		
Knoxville.....	40,000	8	5	5	0	7[12]	2	8	*35	46.9	30-30
Memphis	70,000	8	5	5	0	2	2	10	*32	61.8	50-8
Nashville.....	80,000	12	6	8	0	4	(2)	5	37	131.3	15-7
Av. of all works.	34,500	9.86	4.86	5.71	.86	5.71	2.29	7.5	36.94	88 5	29-15.2
Av. of pub. "	80,000	12	6	8	0	4	2	5	37	131.3	15-7
Av. of priv. "	26.917	9.52	5.67	5.33	1	6	2.33	8.08	43.1	64	32.5-17.2[9]
KENTUCKY.											
Bellevue	3,000	10	4	7.5	2.5	3.75	2	5.5	*35.25	66.7	20-20
Bowling Green	8,500	16.5[13]	5	7.5	2	1.5	1.5	5	39	59.3	50-40
Covington.....	38,000	8	3	6	1	3	1.5	5	27.5	65.8	15-6
Henderson.	10.000	6	10	3	0	4	1	4	28	87.5	35-10
Lexington.....	26,000	5	5	5	1	4.5	(1)	3	*24.5	67.3	25-15
Louisville.....	165,000	6.6	3	5	1	4.25	1	5	*[14]25.85	151.5	15-6
Maysville.....	8,000	11	8	6	6	6	2	6	*45	93.8	40--25
Newport.....	27,500	8	3	6	2	3	1.5	3	26.5	161.7	10-10
Pineville	1,200	1	0.5	0.5	0.25	0.5	0[6]	0.5	* 3.25	104.2	
Av. of all works.	31,911	8.01	4.61	5.17	1.75	3.39	1.28	4.11	31.65	125.9	26.25-16.5
Av. of pub. "	21,000	9.62	5.25	5.62	1.25	2.88	1.38	4.25	30.25	99.1	27.5 16.5
Av. of priv. "	40,640	6.6	4.1	4.8	2.15	3.8	1.2	4	32.77	136.9	25-16.5
OHIO.											
Akron.....	30,000	6.25	2.5	2.5	0	1.25	1.25	0	*13.75	42.7	16-8
Ashtabula.....	10,000	8.5[15]	4	3.5	0	4.5	1	4	*25.5	160	30-10
Bellaire.....	12,000	8	2	3.25	0	1.5	1.5	3.25	19.5	68 1	
Bellfontaine...	5,000	6	2	2	0	3	0[16]	5	18	80	20-15
Bellevue.....	3,500	5.5	2	2.5	0	2	1	0	13	54.3	25-sp.
Canton	25,000	8	0	0	0	1	(1)	5	15	60	
Chillicothe....	12,000	7	3	2	0	2	0[16]	0	*14	104.2	20-15
Cincinnati.....	275,000	8	3	6	1	3	2	1	24	224.2	9-9
Circleville. ...	10,000	7.5	2	2	2	2.5	1	7	*24	90	30-15
Cleveland.....	230,000	6.88	2.5	2.5	0	1.22	(1)	0	14.1	116.7	6¾-6¾
Clyde	3,000	6	2	3	1	2	1	0	15	75	25-sp.
Columbus.....	108,000	8	3	4	0	3.5	2	5	25.5[17]	86	20-6[4]
Dayton.....	55,000	6	2.5	2	2	2.5	(1)	3	19	96.8	40-8
Defiance.....	8,500	8	3	5	1	2.5	1.5	5	*26	102.9	40-15
Dennison & U.	7,000	6.5	5	3.5	1	3	1.5	5	*25.5	125	35-15

Anniston Water Supply Co. [3] Including 5 extra for kitchen sink. [1-2] Including 3 extra for kitchen boiler. Bienville Water Supply Co. [11] Discounts on bills above $5 per quarter, according to amount. [11] City Water Co. [12] Allowing 5 for hose. [13] Including 3 extra for kitchen sink. [14] Owned jointly by city and a company. [15] Including 1.5 extra for kitchen boiler. [16] Included under horse and carriage. [17] All fixture rates reduced by ⅛ in '90, and meter charges to uniform rate of 6c.

() Figures in brackets, est. All except meter rates given in dollars. * Owned by a Company; all others Public. sp. indicates that special meter rates are made.

City.	Present population.	Family rate.	Pan closet.	Bathtub.	Wash bowl.	Horse and carriage, with use of hose.	Cow.	Hose.	Total for family.	Cost of works per family.	Range of meter charges per 1,000 galls., in cents.
OHIO--Continued.											
E. Liverpool...	7,500	9.65	2.8	3 33	0	3.33	1.5	3	23.6	34	22-22
Elyria.....	5,500	8	3	3	0	1.5	(1)	5	*21.5	145.6	16-8
Fremont	10,000	6	2	3	0	2	1	0	14	74	25-sp.
Granville.....	1,500	6	5	3	1	2	1.5	2	20.5	60	
Hamilton.....	17,000	6	2.5	3	0	2	1	0	14.5	108.1	25-sp.
Ironton	12,000	8.5	5	3	0	4	1	5	26.5	77.1	
Kent.	4,000	6.9	2.5	2.5	1.5	1.25	1.25	3	*18.9	(193.8)	160-93
Kenton.....	6,000	8	3	6	1	3	1	3	25	85.5	15-15
Lima.	17,000	8	2.5	3.5	0	·	1 5	5	23.5	99.4	30-sp.
Mansfield.....	15,000	8	3	3	·			5	24	66.3	25-25
Marion.....	9,000	8	4	4	1.	5		·	*30.6	(250)	25-10¼
Martin's Ferry	6,000	8.75	3	6	2	1.5	·.	2.5	25.25	95	12·7
Massillon.....	11,000	7.25	2	3.5	0	4	1	5	*22.75	131.8	30-14
Minerva.....	1,200	5	0	2.5	0	1	1	2.5	12	56.7	
Newark.....	17,000	8.25	3.5	3.5	0	3	(1)	5	*24.25	88 2	35-15
Oberlin.....	5,000	6	3	3	0	3	1.5	2	18.5	54	30-20
Salem..... ..	6,000	5	1	3	1	1.5	0.5	5	*17	(166.7)	30-8
Sandusky.....	23,000	8	2.5	3	0	3	1.5	3	21	94.2	15-6
Springfield. ...	35,000	8	2.5	2.5	0	2	1	1	20	59.9	40-10
Toledo.....	80,000	5	3	3	0	3	1.5	1	16.5	78.1	20-3½
Troy.....	5,000	4.5	2	2.5	2	3	(0.5)	3	17.5	80	
Wadsworth....	3,000	6	2 5	1	0	1	1	3	*14.5	25	
Warren..	7,000	8	3.5	4	0	3	(1)	5	*24.5	128 6	35-10
Xenia	10,000	6.75	3	3	0	2.5	1	5.5	*21.75	102.5	25-16
Zanesville.....	27,000	8	5	1	2.5	2	(1)	3	22.5	96.9	
Av. of all works	28,592	7.09	2.76	3.06	.50	2.48	1.11	3.29	20 31	107.1	29.1 -15.01
Av. of pub. "	39,328	7.03	2.63	3.06	.54	2.5	1.14	2.65	19.52	106.9	22.47-11.78
Av. of priv. "	10,000	7 2	2.97	3.06	.47	2.4	1.07	4.36	21.63	111.5	37.64-18.02
INDIANA.											
Anderson.....	6,000	4	1.5	2	0.5	2	0.5	2	12.5	37.5	
Attica..	3,000	6.5	3	3	0	5	0[5]	1	18.5	70	
Bluffton..	3,500	4	1.5	2	0.5	2	0.5	2	12 5	28.6	
Elkhart.....	15,000	9	4	4	2	4	2	5	*30	33.3	30-10
Evansville	60,000	8.5	4.5	4	1	2.5	1*	0	21.5	28.6	
Ft. Wayne...	40,000	5.2	2.4	3.2	0	2	0.8	0	13.6	39.4	10-6¼
Greencastle...	9,000	7.6	4	4	0	3	1.2	5	*24.8	166.6	40-10
Indianapolis..	120,000	7	3	3	0	5	1.5	6	*25.5	83.3	25-6
Kendallville..	3,000	2	2	2	1.5	2	1	3	13.5	30	
Ligonier.....	2,500	4	2	2	1.5	2	1	3	15.5	30	40-sp.
Marion	11,000	4	3	2	0.5	1	0 5	2	13	20.5	
Michigan C'y..	10,000	6	3	4	2	2.5	(1)	6	24.5	30	40-sp.
New Albany...	30,000	7	2	3	1.5	4	1	1	*19.5	45.8	15-5
Peru.....	10,000	6.5	2	2	0	2	2	4	18.5	63.8	17 5
Plymouth.....	3,500	3.5	(3)	2	0	2	(1)	2	13.5	25.4	
Richmond C'y.	17,000	7.2	3	5	1	4.25	1	3	*24.65	117.7	50-6
South Bend....	23,000	4	3	3	1	2.5	2	2	17 5[5]	54.4	8-6
Terre Haute...	40,000	7	4	5	0	5	1.5	6	*28.5	47.5	30-11½
Valparaiso.....	7,000	9	4	4	2	4	1	5	*29	71.4	30-sp.
Vincennes.....	15,000	7	4	5	0	9	2 5	6 5	*34	125	50-sp.
Wabash.....	10,000	8	3	4	0	2	1.5	5	*23.5	87.5	40-20
Warsaw.....	4,000	(6)	4	5	2.5	4	2	5	*28.5	118 8	30-sp.
Washington...	5,000	9	4	4	0	4	2	5	*28	130	50-20
Av. of all works	19,456	6.17	3.04	3.36	.76	3.29	1.24	3.46	21.33	63.69	31.56-8.6
Av. of pub. "	14,625	4.85	2.58	2.6	.71	2.3	.94	2.25	16.22	38.61	2.3 -5.83
Av. of priv. "	24,727	7.62	3.55	4.18	.82	4.39	1.56	4.77	26.9	79 87	35.45-9.8
MICHIGAN.											
Adrian	10,000	9	5	4	0	5	1.5	6	*30.5	(75)	20-10
Allegan	3,000	4	1	2	0	1	0.5	2	10.5	75	40-20
Alpena.....	10,000	7	2	2	0	2	(1)	5	*19	100	20-10
Battle Creek. .	15,000	4	3	2	0	3	2	3	17	46.1	25- 8
Bay City.... ..	33,000	7	2	3	0	3	(1)	5	21	68.2	10- 5
Bellaire	600	6	(2)	1	0	4	(1)	3	*17	45.8	
Bessemer.....	5,000	18	8	6	0	10	3	(8)[6]	*53	50	70-20

[3] Included under horse and carriage. [5] Extra charges if self-closing faucets are not used. [6] Special rate.

( ) Figures in brackets, est. All except meter rates given in dollars. * Owned by a Company; all others Public. sp. indicates that special meter rates are made.

City.	Present population.	Family rate.	Pan closet.	Bath tub.	Wash bowl.	Horse and carriage, with use of hose.	Cow.	Hose.	Total for family.	Cost of works per family.	Range of meter charges per 1,000 galls., in cents.
MICHIGAN--Continued.											
Cheboygan.....	5,000	5.5	2	2	0	2	(1)	5	17.5	39	20-10
Constantine	1,800	4			0			4		61.8	
Detroit.	200,000	5	3	2	2	2	1	5	20	106.7	10-10
E. Saginaw.....	33,000	8	3	2	0	4	1	3	21	76.2	12- 6
Flint City.....	13,000	5	3	2	0	2	1	4	*17	20.3	50-15
Ft. Gratiot.....	2,800	7	3	2.5	1	2	1	5	21.5	51.8	sp.-sp.
Grand Haven...	6,000	9	5	4	0	3	1.5	6	*28.5	108.3	30-15
Grand Rapids..	60,000	8	4.5	3.5	0.5	2.5	1	4	24	58.8	26⅔-4½
Hillsdale.....	4,000	4	2 5	2	0	2	0.5	2	13	72 5	40-35
Holland	4,000	3	1	2	0	2	0.5	3	11.5	35.3	20 10
Ionia.....	5,000	4	3	(2)	0	1	1	4	15	100	
Ishpeming.....	10,000	8	3	3	0	2	1	2.5	19.5	36	20-20
Kalamazoo.....	22,000	4	2.5	2	2	3	2	4	19 5	79.5	40-25
Kake City.....	700	*10								42.9	
Lansing	12,000	5.5	2.5	2.5	0	2	1	5	18.5	60.4	20- 5
Manistee.....	1,600	6	3	2.5	1.5	3	1	5	*22	62 5	
Marine City....	3,000	6.5	(3)	0	0	1	1	5	16.5	53.3	
Marquette.....	8,000	10	3	5	0	3	1	7	29	111.1	
Menominee.....	10,500	13[7]	3	3	1	2	1	3.75	*26.75	111.9	20-sp.
Mt. Clemens....	4,500	4	2.5	2	0	2	1	2	13.5	54.8	35-25
Muskegon	25,000	5	1	2	0	2	1	6	,17	43.2	40-20
Negaunee.....	6,000	7	3	3	0	1	1	3	18	41.7	
No. Muskegon..	.....	4	1	2	0	2	1	4	14		40-20
Oscoda.....	7,000	3			0			1		14.3	
Petoskey.....	3,500	5	1	0	0	2	(0)	4	12	31.4	40-20
Pontiac.....	6,000	7	2	3.5	0	2	1	5	20.5	70.8	30-sp.
Port Huron.....	13,500	7	3	2.5	1	2	1	5	21.5	88.8	sp.-sp.
Reed City.....	2,500	5	(3)	(0)	0	2	0.5	6	16.5	28	
Traverse City..	4,400	7	2	2	1	4	2	6	*24	43.8	40-20
Vassar.....	2,500	5	2.5	2.5	0	2	1	3	16	38	25-8
Av. of all works	15,931	6.47	2.76	2.4	.26	2.57	1.09	4.28	20.05	80.6	29.73-14.85
Av. of pub. "	18,927	5.54	2.44	2.2	.24	2.1	.96	4	19.6	82 29	27.41-14.79
Av. of priv. "	8,140	9	3.66	2.94	.39	3.9	1.44	5.19	26.42	70.36	35.71-15
ILLINOIS.											
Aurora.....	20,000	4	2	2	0	1.5	1	3	13.5	47	20-sp.
Belleville.....	17,000	7	3	6	3	4	2	3	*28	55.9	6⅔-sp.
Bloomington....	28,000	8	3	4	0	3	1.25	8	27.25	25	25-12
Canton	5,000	9	3	3	0	2	(1)	5	23	28	
Carthage.....	2,500	6			0			0		28	
Champaign and Urbana	9,500	9	4	5	2	4	2	6	*32	118 4	35-13
Chicago.....	875,000	10	0	0	0	2	0	3	15	83.9	10 8+
Clinton..... ..	4,000	4.75	2	2	0	2	1	4	15.75	46.3	
Danville.....	1,200	10[8]	5	5	2	6	2	5	*35	104.2	50-20
Elgin.....	21,000	6	2.5	0	0	3	1	1	13.5	38.6	30-sp.
Eureka.....	1,500	6	0	0	0	(3)	(1)	0	10	21.6	
Galena.....	9,000	8.25	2.5	3.5	0	3	1.5	5	*23.75	41.7	50-15
Jacksonville....	12,000	8	3	3	5	4	2	5	30	83.3	25- 8
Kankakee.....	8,000	9	4	4	2	4	2	5	*30	100	30-10
Kewanee.....	4,300	9	4	4	2	4	2	5	30	40.7	
Lemont.....	4,500	5	6		0					23.3	
Moline	10,000	6.5	4	3	0	2	1	5	21.5	52.5	20- 8
Monmouth	6,000	5.5	2.5	3	1	2	1	4	19	30.8	40-20
Morrison.....	2,000	6	0	0	0	(2)	(0)	10	18	57.5	
Mt. Carroll.....	2,000	6	(4)	(4)	0	2	1	4	21	45	
Oak Park.....	5,000	12	3	3	0	2	0	6	*26	100	30-15
Paris.....	5,000	7	4	5	0	5	1.5	5	27.5	53.3	30-15
Peoria.....	45,000	8	3	3	0	2	(1)	5	*22	50	20- 6+
Petersburgh....	2,500	5	3	3	3	3	0.5	5	22.5	47	5- 5
Rockford..... ..	22,500	6	2.5	3	0	3	0[9]	4	18.5	85.5	40-20
Rock Island....	17,000	8	3	3	0	2	(1)	3	20	83.5	40- 6
Rogers Park....	1,500	8	3	3	0	3	1 5	5	*23.5	23.3	50 20

[7]Including 3 extra for kitchen boiler. [8]Including two extra for kitchen sink.
[9]Included under horse and carriage.
( ) Figures in brackets, est. All except meter rates given in dollars. * Owned by a Company, all others Public. sp. indicates that special meter rates are made.

City.	Present population.	Family rate.	Pan closet.	Bath tub.	Wash bowl.	Horse and carriage, with use of hose.	Cow.	Hose.	Total for family.	Cost of works per family.	Range of meter charges per 1,000 galls., in cents.
ILLINOIS--Continued.											
Sandwich.....	3,000	6	2.5	1	0	2	1	3	15.5	60	25-10
Shelbyville.....	3,500	10.5[10]	2	4	2	3.5	2	3	*25	142.9	50-17½
So. Evanston...	3,000	5	2.75	2.5	0	0.75	0.5	3.5	15	108.3	20-20
Sterling & R. F's	8,300	13[11]	4	4	1.6	3	2	8	*35.6	180.7	25-sp.
Streator.....	15,000	9.25	2.5	3.5	0	3	1.5	5	*24.75	96.6	50-15
Av. of all works	36,681	7.53	2.9	2.98	.74	2.89	1.17	4.55	22.74	79.86	30.28-13.18
Av. of pub. "	50,039	6.51	2.69	2.18	.52	2.54	.93	4.24	19.82	78.73	25.76-12.18
Av. of priv. "	11,181	8.64	3.27	4	1.15	3.5	1.6	5.15	27.78	89.43	39.17-14.38
WISCONSIN.											
Baraboo.....	5,000	8	4	4	2	4	2	5	*29	130	
Beaver Dam...	4,500	8	4	4	2	4	2	5	*29	138.9	30-10
Chippewa Falls	13,000	8	4	4	2	4	2	5	*29	115	30-10
De Pere	2,500	8	3	2	2	3	0[12]	5	*23	23	40-20
Eau Claire....	22,000	8.4	4	4	2	4	2	5	*29.4	(56.8)	30-10
Fond du Lac...	17,000	12[13]	5	5	3	6	2	5	*38	61.8	50-20
Gr'n B & Ft. H.	18,000	8	4	4	2	9	1.5	6	*34.5	83.3	40-20
Hudson.....	3,500	9	4	4	2	4	2	5	30	48.8	
Kenosha.....	7,000	7	4	2	0	5	0[12]	5	*23	20	30-10
La Crosse	28,000	7	3	3	0	3	0.5	5	21.5	33 3	40-15
Madison.....	12,000	6	2.5	3	0	2	0[12]	2.5	16	78.5	31½-8
Milwaukee..	185,000	8	2	3	1	7	1	2.5	24.5	85.1	20-4½
Neillsville.....	2,500	7	3	3	0	3	0.5	5	21.5	(40)	40-15
Portage.....	6,000	8	4	4	2	4	2	5	*29	104.2	30-10
Racine.....	20,000	4.8	4	3.6	0	2.2	1.2	4.8	*20.6	187.5	30-10
Stevens Point.	10,000	8	4	4	2	4	2	5	*29	(75)	35-12½
Stoughton.....	3,500	7	2.5	3	0	2	0[12]	1	15.5	42.9	50-20
Wausau.....	8,500	7	2.5	3	0	1.5	1	1	16	77.7	53½-6¾
Av.of all works	20,444	7.73	3.53	3.48	1.22	3.99	1.2	4.32	25.47	83	36.23-11.21
Av. of pub. "	34,714	8.43	2.8	2.57	0.14	2.64	.71	3.14	20.71	76.7	39.24-12.76
Av. of priv. "	11,364	7.3	4	4.05	1 91	4.84	1.52	5.07	28.5	95.3	33.9 -12.5
IOWA.											
Anamosa.....	3,200	*7				5				35.9	
Atlantic.....	5,000	7	3	3	0	3	0[12]	7	*23	75	40-20
Audobon.....	1,800	5			0			10		22.2	
Burlington....	30,000	9	4	5	0	5	1	(5)	*29	35	40-20
Cedar Falls...	3,500	6.5	3	3	0	3	1	4	20.5	47.3	40-20
Charles City..	3,500	5	3	3	0	3	1	5	20	30	40-20
Council Bluffs	35,000	9.25	2.5	3.5	0	3	1	5	*24.25	114	35-15
Davenport....	31,000	8	4	3	0	3	2	5	*25	118.4	40-10
DesMoines....	45,000	8	3	3	0	13	(1)	10	*38	111.1	40-20
Dubuque.....	30,000	10	3	4	0	3	3	3.5	*26.5	(66.6)	50-20
Fairfield	4,000	5	3	3	0	3	1	4	19	75.3	40-20
Ft. Madison...	10,000	10	4.6	5	0	7	2	5	*33.6	50	
Ida Grove.....	1,800	6	3	3	0	3	(1)	4	20	30	
Iowa City.....	8,000	6.5	3	3	0	3	1	6	*22 5	71.9	40-20
Knoxville.....	3,000	5	2.5	3	0	3	0[12]	(4)	17.5	46 7	35-15
Lyons.....	5,800	8	3	3	0.5	2	2	6	*24.5	66.1	30-10
Marion.....	4,500	6	2.5	5	0	3.75	0[12]	6.5	*23.75	141.1	
Marshalltown	10,000	6	3	3	0	3	1	4	20	53	40-20
Mason City...	3,500	6	3	3	0	3	1	4	20	40	40-10
Monticello....	2,000	6	3	3	0	3	1	5	21	50	
Mt. Pleasant..	4,000	8	5	5	3	10	1	5	*37	(93.8)	50-10
Muscatine	12,000	10	3	4	0	3	2	5	*27	39.6	40-25
Nevada.....	1,600	9	3	3	0	3	1	4	23	37.5	40-20
Oskaloosa.....	10,000	6	3	3	0	3	1	5	*21	78	40-20
Red Oak.....	4,000	8	4	3	0	6	1	6	28	41	18-6
Sioux City..	30,000	6	3	3	0	4	1	4	21	42.3	40-13
Vinton.....	2,700	5	3	1	0	2	1	4	18	53.7	40-20
Av. of all works	11,293	7.08	3.2	3.34	.13	4.07	1.12	5 23	24.12	79.12	39-16.86
Av. of pub. "	5,492	6.04	2 71	2.93		3.25	.92	4 77	20 67	45.1	37.3-16.4
Av. of priv. "	16.679	8.05	3.66	3.73	0.27	4.77	1.31	5.7	27.31	89.52	40.45-32.31

[10]Including 2 extra for kitchen sink, and 1.5 for kitchen boiler. [11]Including 5 extra for kitchen boiler. [12]Included under horse and carriage. [13]Including 2 extra, 1 each for kitchen sink and boiler.

( ) Figures in brackets, est. All except meter rates given in dollars. * Owned by a Company; all others public. sp. indicates that special meter rates are made.

City.	Present population.	Family rate.	Pan closet.	Bath tub.	Wash bowl.	Horse and carriage, with use of hose.	Cow.	Hose.	Total for family.	Cost of works per family.	Range of meter charges per 1,000 galls., in cents
MINNESOTA.											
Duluth	35,000	12	5	5	4	5	2	2	*35	104.6	50-20
Fergus Falls..	5,000	12	5	5	4	5	2	2	*35	168	50-20
Mankato	10,000	5	3	2	0	1	1	2	14	22.5	20-8
Minneapolis	160,000	3.75	3	2 5	1 5	2	1	3	16.75	68.8	8-8
Red Wing	7,000	5	3	3	0	5	1.5	5	22.5	60.7	40-11¼
Rochester	7,500	8	3	4	0	3	1.5	5	*24.5	100	30-10
St. Paul	200,000	4.9	2	2	0	2	2	3	15.9	62.1	20-10
Sauk Center..	3,000	6	(3)	3	0	2.5	1	4	*19.5	24.2	
Av. of all works	53,438	7.08	3.38	3.31	1.19	3.19	1.5	3.25	22.89	68.75	31.14-12.46
Av of pub. "	94,250	4.66	2.75	2.33	.38	2 5	1.38	3.25	17.28	63.84	22-9.31
Av.. of priv "	12,625	9.5	4.5	4.25	2	3 83	1.63	3.25	23.5	105.44	43.33-12.5
KANSAS.											
Arkansas City.	10,000	7	3	5	0	7	1	7	*30	75	50-20
Atchison	25,000	7	5	5	0	7	1	5	*30	40	50-20
Beloit	3,000	5.75	2	3	0	5	0[14]	6	*21.75	90	30-10
Bunker Hill	400	12.6	5	5	0	5	2	7	36.6	212.5	100-65
Caldwell	3,000	7	(3)	2.5	0	1.5	1.5	(5)	*20.5	108.4	sp.-20
Columbus	2,300	13.5	2.7	2.7	0	4	1.4	2	*26.3	130.4	
Council Grove	3,800	7	5	5	0	8	(1)	5	*31	48.7	30-10
Cullison	500	16	0	5	0	1.5	1.75	6	30.5	650.	
El Dorado	6,000	6.8	2.55	2.55	0	(1.7)	1.25	6.4	*21.25	66.7	50-sp
Ellsworth	2,500	5	2	0	0	3	0[14]	6	16	1 0	30-10
Emporia	12,000	7.5	2	0	0	2	2	5	18.5	106 3	
Eureka	5,000	7	2.5	3	0	2.5	1	4	20	50	35-sp.
Florence	2,300	7	3	5	0	7	1	5	*28	91.3	50-12½
Ft. Scott	20,000	8	2	2	0	3	2	1.5	*18.5	62.5	25-sp.
Hiawatha	3,000	6	(3)	3	0	2.5	1	5	20.5	88.4	30-sp.
Hutchinson	8,000	7	3	5	0	7	1	7	*30	46.9	35-15
Junction City.	4,500	6.5	1.6	0	0	1	1	3	13.1	66.7	1⅝-1⅝
Larned	5,000	8	(2)	2.5	0	1.5	1.5	5	*20.5	130	sp.-20
Lawrence	13,000	7	2	2	0	3	1	2	*17	80.8	50-sp.
Leavenworth .	31,000	12	5	5	0	12	1	5	*40	62.9	50-20
Manhattan	5,000	7	5	3	0	1	1.6	5	22.6	72	50-12½
Marion	3,500	8	3	2.5	0	1.5	1.5	7.5	*24	114.3	50-sp.
Minneapolis..	3,600	4.9	2.6	2.9	0	7	1.5	4.6	*23.5	104 2	35-15
Paola	4,000	9.5	5	6	3	4	1.5	5	*34	112.5	50-sp.
Parsons	10,000	10	2	3	0	3	1	1.5	*20.5	47.5	
Pittsburgh	5,000	10	2	2	0	3	1	10	*28	55	
Salina	10,000	7	3	5	0	7	1	5	*28	53.5	30-20
Sterling	2,800	6.5			0			0		89.3	50-30
Stockton	2,000	5	(3)	5	0	5	0[14]	5	23	85.8	30-10
Topeka	40,000	7	3	5	0	7	1	7.5	*30.5	125	50-12½
Wellington	10,000	10	2	2	0	3	2	1.5	*20.5	45	25-sp.
Wichita	35,000	7	0	2.5	0	1.5	1.5	5	*17.5	57.1	sp.-20
Winfield	8,000	7	2	3	0	(3)	1.5	6	*22 5	93.8	50-20
Av. of all works	9,067	7.96	2.78	3.29	.09	4.18	1.2	4.89	24.52	76.64	41.47-18.21
Av. of pub. "	3,770	7.91	2.68	2.67	0	2 64	1.15	4 6	22.31	93.66	10.83-21.5
Av. of priv. "	11,326	7.98	2.82	3.53	0.13	4.68	1.22	5.02	25.38	74.19	41.75-16.86
NEBRASKA.											
Albion	1,500	8.25	2.5	2.5	0	1.5	0.75	3	18.5	31.6	35-12½
Ashland	1,800	6	2.5	3	0	2.5	(1)	4	19	52.8	35-15
Aurora	1,800	8.25	3	2	0	2	1	5	21.25	75	35-15
Beatrice	10,000	6	2.5	3	1	2.5	1.5	5	21.5	40	35-15
Blair	3,000	5	2	2	0	2	1	4	16	38.3	30-10
Falls City	2,600	6.3	2.25	2.7	0	2.25	0.9	3.6	18	50	35-sp.
Grand Island..	12,000	7.25	2.5	1.5	0	1.5	0.75	3	16.5	31.3	12½-8
Hastings	12,000	8.25	3	3	0	1.5	1.5	5	22.25	41.7	35-15
Lincoln	40,000	6	2.5	3	0	2.5	1.5	5	20.5	18.5	10-10
Nebraska City.	10,000	10	6	6	3	4	2.5	12.5	*44	100	35-15
Neligh	1,500	5	2.5	5	0.75	2	0.75	5.4	21.4	35	
Omaha	120,000	8.25	2.5	3.5	0	3	0[14]	5	*22.25	166.7	35-15
Plattsmouth	7,500	10	5	4	2	8	2	6	*37	(66.7)	35-15
Superior	25,00	5	2.5	3	0	2	0.5	3	16	51	30-sp.
Valparaiso	700	6	2.5	3	0	2.5	1.5	5	20.5	(107.4)	35-15

[14] Included under horse and carriage.

( ) Figures in brackets, est. All except meter rates given in dollars. * Owned by a Company; all others Public. sp. indicates that special meter rates are made

City.	Present population.	Family rate.	Pan closet.	Bath tub.	Wash bowl.	Horse and carriage, with use of hose.	Cow.	Hose.	Total for family.	Cost of works per family.	Ranges of meter charges per 1,000 galls., in cents.
NEBRASKA--Continued.											
West Point....	2,000	6.5	1.5	2.5	0	2	0.75	3	16 25	40	35-15
York.....	5,000	10.25	2.5	3.5	0	3	(1.5)	5	*25.75		35-15
Av. of all works	13,759	7.19	2.81	3.13	.29	2.63	1.14	4.85	22.16	106.55	31.41-13.61
Av of pub. "	7,031	6.45	2.44	2.78	.13	2.06	1.03	4.15	19.05	31.62	30.21-13.05
Av. of priv. "	35,625	9.63	4	4.25	.5	4 5	1.5	7.13	32.25	156.36	35-15
SOUTH DAKOTA.											
Huron.....	5,000	7.5	2.5	2.5	0	2	0.5	2.5	17.5	29	
Mitchell..	5,000	8.25	2	0	0	3	(0.5)	4	17.75	65	
Pierre	5,000	21	8	6	0	10	0.15	12.5	*37.5	159.1	70-20
Sioux Falls ...	11,000	7.25	3.5	3 5	1	2	1.5	8	*26.75	50	35-15
Spearfish.....	1,200	18	3	3	0	3	1	6	34	72.9	
Av. of all works	5,440	12.4	3.8	3	.2	4	.7	5.8	30.7	70.05	52.5-17 5
Av. of pub. "	3.733	11.25	2.5	1.83	.0	2.67	.67	4.17	23.8	49.77	
Av. of priv. "	8,000	14.13	5.75	4.75	.5	6	.75	8.25	42.13	84.22	52.5-17.5
NORTH DAKOTA.											
Grand Forks...	7,000	20	5	3	3	6	0[15]	0.35	37.35	71.4	50-20
Wahpeton.....	2,500	13	5	(4)	0	5	(2)	3.25	*32.25	160	50-20
Av. of all works	4,750	16.5	5	3.5	1.5	5.5	1	1.78	34.80	94.74	50-20
One public and one private work.											
MONTANA.											
Billings..... ..	3,000	10	5	5	2	5	(2)	7.5	*36 5	83.3	100-100
Butte.....	8,000	21	0	6	0	18	3	12	*60	93.8	50-20
Av. of all works	5.500	15.5	2.5	5.5	1	11.5	2.5	9.75	48.25	90.91	75-60
All private works.											
MISSOURI.											
Carrolton	4,000	9 5	4.6	5	0	5	2	6	*32.1	37.5	35-15
Hannibal	19,000	9	5	5	2	7	1.5	4.5	*34	35.3	50-20
Independence	6,000	10	2	3	0	3.5	2	2	*22.5	75	35-25
Kansas City....	110,000	8	4.5	5	0	7	2	4 5	*31	205.7	36-9
Lexington.....	5,000	8	3	4	0	2	1.5	4.5	*23	93	40-20
Maryville..... ..	5,000	8	2	2	0	3	1	1.5	*17.5	85	25-sp.
Mexico....	7,000	8	3	4	0	2	1.5	4.5	*23	59 3	50-20
Moberly	10,000	7	3	4	0	2	1.5	4.5	*22	50	50-20
Rich Hill.....	6,000	4	2	2	1	1.4	0.8	5	*16.2	40	50-20
St. Joseph.....	78,000	7	5	5	0	7	1	5	*30	51.2	50-20
St. Louis.....	450,000	7	5	5	0	8	(1.5)	2.5	29	148.3	30-10
Sedalia.....	22,500	7	5	5	2	8	3	2.5	*32.5	92.2	30-12½
Springfield	30,000									64.2	*35-10
Washington....	6,000	7	5	5	2	8	3	2.5	*32 5	50	30-12½
Av. of all works	54,179	7.65	3.78	4.15	.05	4.92	1 71	3.81	26.56	133.39	39-16.46
Av. of pub. "	450,000	7	5	5	0	8	1.5	2.5	29	148.03	30-10
Av. of priv. "	23,731	7.71	3.43	3.25	.06	4.66	1.67	3.91	26.4	111.67	39.6 17
ARKANSAS.											
Ft. Smith.....	20,000	10	2	2	0	3	2	2	*21	57.5	25-25
Pine Bluff.	16,000	7	5	5	0	8	3	2.5	*30.5	46 9	30-12½
Texarkana.. ..	10,000	15	5	7.5	0	8	3	5	*43.5	38	50-10
Av. of all works	15,333	10.67	4	4.83	0	6.33	2.67	3.17	31.67	49.57	35-15.83
All private works.											
TEXAS.											
Beaumont.....	3.500	*12		6	0			12		28.6	
Belton.	5,000	12	5	6	0	6.5	1.5	5	*36[16]	45	sp.-sp.
Brenham.....	7.500	16	5	6	0	12	0[15]	(10)	*49	45.3	100 40
Calvert.....	3,500	12	5	6	0	6.5	1.5	5	*36	25.	50-50
Columbus..	3,000	7.7	5	4.6	0	3.85	0[15]	3.85	25	50	
Dallas.....	45,000	12	9	10	0	12	0[15]	(10)	53	38.9	
Del Rio.....	1.800	24	9	12	0	15	0[15]	(10)	*70		
Denison.....	15,000	20	10	6	0	18	0[15]	(5)	*59	133.3	50-50
El Paso.....	10.600									56 6	*75-20[17]
Ft. Worth..	30,000	12	5	6	0	6.5	1.5	(5)	36	53.3	45-20

[15] Included under horse and carriage. [16] Built by town; leased and operated by company. [17] All fixtures metered.

() Figures in brackets, est. All except meter rates given in dollars. * Owned by a Company; all others Public. sp. indicates that special meter rates are made.

City.	Present population.	Family rate.	Pan closet.	Bath tub.	Wash bowl.	Horse and carriage, with use of hose.	Cow.	Hose.	Total for family.	Cost of works per family.	Range of meter charges per 1,000 galls., in cents.
TEXAS--Continued.											
Galveston	40,000	6	3	6	2	4	1.5	3	25.5	56 3	30-sp.
Greenville	7,000	12	9	10	0	12	0[15]	(10)	*53	87.8	
Laredo	8,500	24	0	0	0	(4)	(0)	0	*28	70.6	50-3½
Marshall	8,500	10	(?)	0	0	2	0	5	20	39.4	
Mexia	3,500	12	8	5	0	11	3	7.5	*46.5	42.9	
Morgan	700	6	3	3	0	4	0[15]	2	*18	50	20-10
Navasota	4,000	*16[16]	0	0	0					25.6	
Paris	12,000	18	7	9	0	13	3	(8)	*58	42.5	
San Angelo	4,000	40.8	6	9	0	4.2	4.2	30	*94.2	50	50-50
San Antonio	45,000	12	6	6	0	3	3	18	*48	(66.6)	50-25
Tyler	7,000	12	10	12	0	13	3	9	*59	82.1	25-15
Waco 17½	22,000									79.5	*100-40
Weatherford	5,000	14	3	6	0	12	0[15]	2	*37	65	50-10
Av. of all works.	12,700	14.79	5.55	6.12	0	8.56	1.17	8.02	44.8	61.44	53.46-27.79
Av. of pub. "	25,300	9.54	5	5.32	.40	5.67	6	5.37	31.9	48.52	37.5 -20
Av. of priv. "	9,200	16.43	5.73	6.6	.09	9.59	1.38	8.9	49.41	70.74	56.82-28.5
COLORADO.											
Berthoud	300	15	2	2	0	4	2	9	*34	200	
Buena Vista	1,200	13	10	5	0	(3)	(1)	0	32	135 4	
Cañon City	3,100	14	6.75	6.5	0	10.8	1.35	4.4	43.8	96.8	
Central City	7,000	39	6	6	0	6	3	6	66	57 1	100-sp.
Colorado Sp'ngs	8,000	14 5	0	0	0	0	0	0	14.5	187.5	
Denver	90,000	7	5	5	0	8	1	12	*38	68.1	20-15
Ft. Collins	3,000	16	3	1.6	0	3	2	(5)	30.6	175	
Grand Junction	1,500	24	6	6	0	6	3	4.5	*49.5	200	30-12½
Gunnison	2,000	7	5	3	0	6	1	5	*27	214.8	60-28¾
Highlands	7,000	7	5	5	0	8	1	10	*36	63.6	20-12½
Idaho Springs	2,000	7	5	5	0	5	1	2	25	75	60-28¾
La Junta	1,500	*12	6	6	0					100	
Las Animas	2,000	6	3	3	0	6	0[15]	6	24	75	
Leadville	20,000	24	6	6	0	6	6	12	*60	125	75-40
Longmont	1,800	15	2	2	0	4	2	6	31	208 3	
Morrison	250	*10			0			12		70	
Trinidad	7,000	12	5	5	0	6	0[15]	6	*34	80	50-20
Av. of all works	9,273	14.26	4.73	4.19	0	5.45	1.62	6.24	36.36	89.75	51.88-22.5
Av. of pub. "	3,513	15.56	4.94	3.64	0	4.73	1.29	5.18	33.36	126.78	80 -28.75
Av. of priv. "	14,394	13.11	5	4.75	0	6.29	2	7.31	39.79	81.72	42.5 -21.46
NEW MEXICO.											
Albuquerque	8,000	18	8	8	2	7	2	20	*65	75	50-12½
Silver City	3,000	30	0	0	0	9	6	(15)	*60	150	75-75
Av. of all works	5,500	24	4	4	1	8	4	17.5	63.5	100	63.5-43.75
All private works.											
WASHINGTON.											
Palouse	1,000	21	6	3	0	3	3	0	36	45	20-15
Spokane Falls	16,000	21	6	3	0	3	3	0	36	55.31	20-15
Tacoma	30,000	15	6	6	0	6	(3)	5	*41	50	25-15
Av. of all works.	15,667	19	6	4	0	4	3	1.67	37 67	51.78	21.67-15
Av. of pub. "	8,500	21	6	3	0	3	3	0	36	54.71	20-15
Av. of priv. "	30,000	15	6	6	0	6	3	5	41	50	25-15
OREGON.											
Albany	2,500	*18			0					30	
Arlington	1,000	24	12	12	0	12	(3)	12	*75	35	
Coquille	600	*9								25	
E. Portland	10,000	24	12	12	0	12	12	15	*87	56.5	75-50
Eugene	3,000	18	6	6	0	6	6	15	*57	(75)	50-40
Hood River	200	18	9	6	0	12	6	3	*54	50	30-20
Milton	900	12	(5)	0	0	6	1.2	1	25.2	27.8	25-15
Pendleton	3,300	18	6	0	0	6	3	2.4	35.4	60.6	60-50
Portland	40,000	9	9	6	0	12	6	9	51	75	30-16⅔
Av. of all works.	6,833	16.67	8.43	6	0	9.43	5.71	8.2	54.94	67.48	44.17-31.94
Av. of pub. "	14,733	13	6.67	2	0	8	3 4	4 13	37.2	72.97	38.33-27.22
Av. of priv. "	2,883	18.5	9.75	9	0	10.5	6.75	11.25	68.25	53.47	51.67-36.67

[17]½ Waco Water & Power Co. [15] Included under horse and carriage. [16] Built y town, leased and operated by individual.
( ) Figures in brackets, est. All except meter rates given in dollars. * Owned by a Company; all others Public. sp. Indicates that special meter rates are made.

City.	Present population.	Family rate.	Pan closet.	Bath tub.	Wash bowl.	Horse and carriage, with use of hose.	Cow.	Hose.	Total for family.	Cost of works per family.	Range of meter charges per 1,000 gallis., in cents.
CALIFORNIA.†											
Alameda	10,000									184	*35–20[19]
Auburn	2,600	24	0	0	0	12	0[21]	0	*36	76.5	
Benicia	2,000	30	6	9	0	9	3	(5)	*62	143.3	75–10
Cloverdale	1,200	18	12	6	0	9	3	12	*60	62.5	37½–20
Cucamonga	300	*12			0					1,716.6	
Haywards	2,000	18	(6)	6	0	6	3	(5)	*41	75	60¾–51¼
Hollister	2,000	18	6	(9)	0	6	3	4.8	*37.8	87.5	
Los Angeles	50,000	18	0	0	0	1.8	(1.2)	3	*24	‡1,375	15–10
Modesto	3,200	18	6	6	0	6	6	4.8	*46.8	62.5	50–35
Napa	5,000	21	6	6	0	3	3	4 8	*46.8	126 6	50–37½
National City	6,000	14	6	4	0	4	4	7	*39	650.4	55–sp.
Nipomo	500	*18								235	
Oakland	45,000	22	4.2	6	0	6	2.4	6	*46.6	57	50–30
Ontario	2,000	19 2	4	4	0	2	2	2	*33.2	‡330	
Pacific Grove		36	6	6	0	9	3	10	*70		75–45
Pasadena	9,000	*16.2[21] *14.1[22]					1.2 0.6	9		‡80	25–25 60–60
Portersville	600	24	6	6	0	6	3	4.8	*49.8	95.8	50–37½
Pomona	5,000	18	3	0	0	3	3	3	*30	100	25–25
Red Bluff	3,500	18	6	0	0	3	3	3	*33	214.3	50–37½
Redding	3,000	30	18	0	0	0	0	5	*53	70	50–50
Riverside	6,000	12	4.2	3	0	3	3	2.5	*27.7	250	
Sacramento	35,000	12	0	4	0	10	4	4.8	34.8	51.14	45½–22½
Salinas	3,500	15	6	0	0	6	3	4.8	*34.8	72.9	50–25
San Diego	25,500	24	12	9	0	6	6	12	*69	141.2	50–30
San Francisco	250,000	14.4	3	4 8	0	4 8	2.4	5.5	*34.9	342.5	40–21½
San Luis Obispo	3,500	33	12	6	0	9	3	9.5	*72.5	142.9	
Santa Barbara	8,000	24	6	6	0	9	(3)	4.8	*52.8	184.4	100–35
Santa Rosa	7,000	15	6	3	0	6	3	6	*39	110	50–40
Stockton	16,000	18	6	6	0	18	3	6	*57	34.4	50–35
Themalito C'l'ny.	3,000	12	4.8	3	0	6	2.4	9	*37.2	416.6	35–20
Tulare	2,500	18	6	6	0	6	3	4.8	*43.8	125.1	50–37½
Vallejo	5,000	39	6	9	0	6	(3)	6.6	*69.6	300	100–75
Ventura	3,500	18	18	3	0	6	3	4.8	*52.8	218.1	100 100
Av. of all works.	16,419	19 53	6.04	4.2	0	6.26	2.78	5.68	46.13	289.71	53.28 37.13
Av. of pub. "	35,000	12	0	4	0	10	4	4.8	34.8	51.14	45½–22½
Av. of priv. "	15,819	19.76	6.26	4.21	0	6.13	2.74	5.71	46.54	302.67	53.62–37.71
One public work.											
ARIZONA.											
Phœnix	7,000	24	8.4	0	0	(6)	(3)	4.8	*46.2	55	70–40
UTAH.											
Ogden	10,000	10	0	0	0	(4)	(1)	5.5	20	53	
Salt Lake City	30,000	6	2	2	0	(4)	(1)	5.5	20.5	66.7	20–20
Av. of all works.	20,000	8	1	1	0	4	1	5.5	20.25	63.25	20–20
All public works.											
IDAHO.											
Bellevue	2,000	24	0	0	0	(4)	(1.5)	6	*35.5	37.5	
Pocatello	2,000	*18			0					30	
Av. of all works.	2,000	21	0	0	0	4	1.5	6	35.5	33.75	
All private works.											
NEW BRUNSWICK.											
Fredericton	7,000	5	5	3	1	5.5	1	3	23.5	79.3	25–15
PRINCE EDWARD ISLAND.											
Charlottetown	12,000	6	5	3	1	3	1	2	21	63.75	30-30

[19] All water metered; 35c. for domestic, 20 for mfg. use. [20] Included under horse and carriage. † Town Board of Supervisors establish rates for both private and public works. [21] P. Land & Water Co. [22] No. P. Land & Water Co. ‡ Two companies.

( ) Figures in brackets, est. All except meter rates given in dollars. * Owned by a Company; all others Public. sp. indicates that special meter rates are made.

City.	Present population.	Family rate.	Pan closet.	Bath tub.	Wash bowl.	Horse and carriage, with use of hose.	Cow.	Hose.	Total for family	Cost of works per family.	Range of meter charges per 1,000 gals., in cents.
NOVA SCOTIA.											
Bridgetown	2,000	5	4	(2)	(1)	6	0.5	3	21.5	55	
Halifax	45,000		4[24]			1[24]	1[24]			88.8	
Truro	6,000	6	3	1	0	2	0[25]	0	12	39.2	
Yarmouth	7,000	10.2	5	5	3	20	3	10	*56.2	155	50–35
Av. of all works.	15,000	7.07	4	2 67	1.33	7.25	1.13	3.25	29.9	90.5	
Av. of pub. "	17,778	5.5	3.67	1.5	.5	3	.5	1.5	16.75	81.93	50–35
Av. of priv. "	7,000	10.2	5	5	3	20	3	10	56.2	155	50–35
QUEBEC.											
Hull	13,000		2	0	0	2	1			45.38	
Joliette	4,000	11								62.5	
Longueuil	3,500	14 3	2	4	0	1	0.5	0.5	22.3	114.3	30-15
Montreal	200.000	14	4	0	0	2	1	2	23	166.14	30.15
Quebec	62,400	18.75	2	0	0	1	1	(2)	24.75	160.3	
St. Hyacinthe	10,000	*16			0					70.5	
Sherbrooke	8,000	12	4	4	2	4	3	8	*37		35–20
Valleyfield	5,300	10.25	4	0	0	2.5	1	2	19.75	60 8	
Av. of all works.	38,275	13.76	3	1.33	.29	2.08	1.25	2.9	25.36	152.67	31⅔-16⅔
Av. of pub. "	48,033	13.66	2.8	8	0	1.7	.9	1.63	22.45	155.41	30–15
Av. of priv. "	9,000	14	4	4	1	4	3	8	.7	70.05	35–20
ONTARIO.											
Brantford	13,000	7	5	5	1	2.5	2	6.25	*28.75	24.2	21⅓-sp.
Brockville	9,000	13	4	3	0	2.5	1.5	5	*29	111.1	30–30
Chatham	11,000	*6.9			1.15			6.9		(90.9)	35–11½
Cobourg	5,000	6	3.5	3	1	3	2	5	*23.5	100	25–sp.
Cornwall	5,000	6	3.5	3	1	3	2	5	*23.5	125	25–sp.
Dundas	3,000	8	3	2	0	4	1	12	30	68.3	
Hamilton	45,000	10.4	3	2	0	1.4	(1)	8	25.8	122.2	30–sp.
Kingston	16,000	11	3.2	4.8	0					56.3	84–20
London	35,000	8	3.5	4	0	2	1	4	22.5	74.2	33⅓-20
Merritton	2,000	5	2	2	1	2	1	3	16	175	
Morrisburg	2,000	5	3	2	0	2	(0.5)	2	14.5	67.5	
Niagara Falls	3,800	6	2	2	1	(2)	1	2	16	31.6	
Ottawa	36,000	12	2	0	0	2	1	(4)	21	164.6	8-8
Owen Sound	6,600	9	3	2	1	2	1	4	*22	45.5	
St. Catherines	11,000	5	2	2	1	2	1	3	16	146.5	20–14
St. Thomas	10,300	5	2	2	1	1.5	1	4	16.5	34	sp.–sp.
Sarnia	5,800	6	4	3	1	1.5	0.75	3.2	19.45	61.5	
Stratford	9,000	8.3	3.5	4.5	0	2	1	4	*23.3	42.9	
Toronto	126,000	13	5	5	2	4	1	4	34[26]	117 9	30-30[27]
Welland	2,000	5	3	2	0	2	1	4	17	117.5	
Wiarton	2,000	7	3	3	0	2	1	6	22	37.5	sp.–sp.
Windsor	9,500	13	5	4	0	2	1	4	29	94.7	25–sp.
Woodstock	9,000	5	2.5	2	1	1.5	1	4	17	36.1	
Av. of all works.	16.391	7.85	3.21	2.83	.57	2.23	1.13	4.7	22.22	102.4	30.55–19.05
Av. of pub. "	19,900	7.71	3.01	2.61	.47	2.13	.95	4.48	21.12	108.3	32.90–18.07
Av. of priv. "	8,371	8.03	3.75	3.42	.71	2.5	1 58	5.16	25.01	70.4	27 27–21.74
BRITISH COLUMBIA.											
Vancouver	15,000	15.6	3	6	0	6	3	(6)	*39.6	83 33	60–sp.

[24] Extra charges; revenue largely derived from taxation. [25] Included under horse and carriage. [26] Payable semi-annually, in advance; if paid within 2 months after due 50% discount with 10% off balance will be allowed. [27] Payable quarterly, with same discounts as above if paid within 1 month.

( ) Figures in brackets, est. All except meter rates given in dollars. * Owned by a Company; all others Public. sp. indicates that special meter rates are made.

NOTICE.

The following list of advertisers, together with those on the first cover pages, forms a very complete directory of the representative firms and individuals engaged in planning, building and financiering the Water-Works of America, and also manufacturing the materials and machinery that enter into their construction and maintenance.

A CLASSIFIED INDEX

To advertisements will be found in the front of the book.

A DIRECTORY

Of Water-Works Superintendents, Secretaries, Engineers and Contractors alternates with the following advertising pages.

NOTICE.

THE ASHTON VALVE COMPANY,

MANUFACTURERS OF

Water Relief Valves

FOR

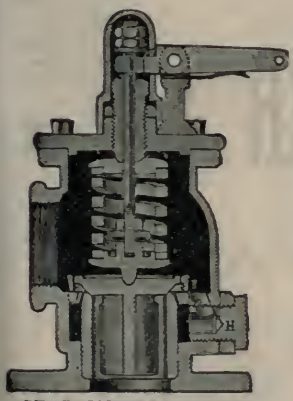
Steam Pumps and Stand Pipes.

ALWAYS CONTROLLING THE PRESSURE

LOCKED "POP" SAFETY VALVES

For Stationary, Marine, and Portable Boilers.

FINE STEAM YACHT VALVES A SPECIALTY.



STATIONARY VALVE.

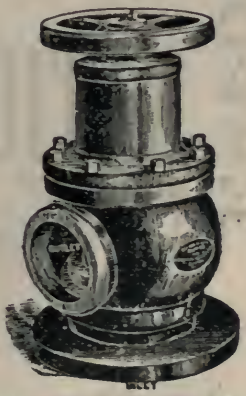
Absolute Security Against

Boiler Explosions.

Automatic, Non-Corrosive,

Durable, Accurate.

Cannot be Tampered with.



WATER RELIEF VALVE.

The product of the ASHTON VALVE COMPANY, of Boston, has become widely known as the best of its kind in material and workmanship. The best skill attainable in the art, together with the most accurate methods known in this department of mechanics, is employed, and every Valve bearing their stamp challenges comparison with the best now made in the world. Send for Catalogue.

OFFICE AND WORKS:

271 FRANKLIN ST., Boston, Mass.

Branch Office: 218 LAKE STREET, CHICAGO, ILL.
" 107 LIBERTY STREET, NEW YORK.

CROWN.

77,000

WATER METERS

MADE AND SOLD

BY

EMPIRE.

NATIONAL METER CO.,

GEM.

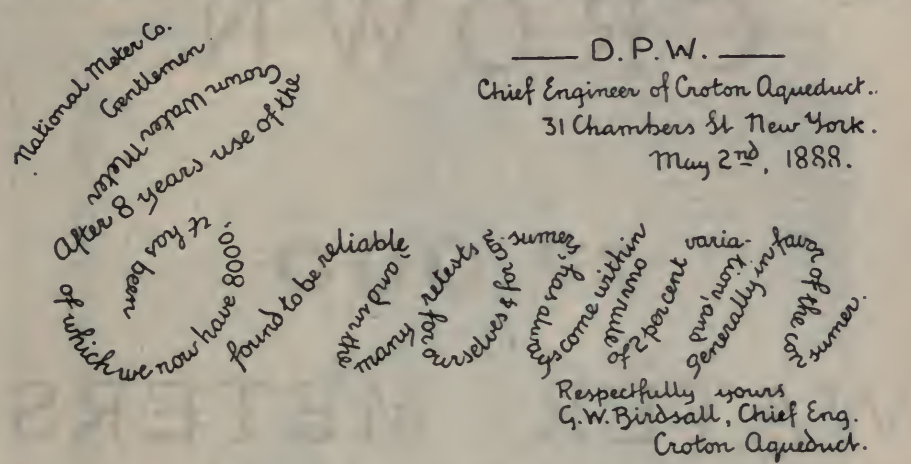
252 BROADWAY,

NEW YORK.

JOHN C. KELLEY, President.

JUNE 1, 1890.

NATIONAL METER CO.



June, 1890.—Number of Water Meters made and sold by us, to the following Water Departments, in excess of one hundred.

New York	9483	Flushing	565	Princeton, N. J.	242
Providence, R. I.	5287	Montgomery, Ala.	551	Los Angeles, Cal	238
Hoboken, N. J.	3305	New Rochelle, N. Y.	526	St. Paul, Minn.	234
Fall River, Mass.	2862	Springfield, Mass.	477	Louisville, Ky	199
Rochester, N. Y.	2490	Burlington, Vt.	470	Tarrytown, N. Y.	185
Pawtucket, R. I.	2450	Toledo, O	463	Lake Village, N. H.	184
Newton, Mass	1912	Syracuse, N. Y	460	Albion, N. Y.	178
Boston, Mass.	1875	Harrisburg, Pa	419	Westerly, R. I.	164
Yonkers, N. Y.	1782	San Diego, Cal.	415	McKeesport, Pa.	158
Brooklyn, N. Y.	1424	Brookline, Mass	389	Minneapolis, Minn	154
Alameda, Cal	1402	Auburn, N. Y.	369	Memphis, Tenn.	146
Atlanta, Ga.	1400	Taunton, Mass.	361	Bay City, Mich.	138
Kansas City, Mo.	1170	Columbus, O	350	East Saginaw, Mich.	134
Toronto, Can	1140	Jacksonville, Fla.	348	Troy, N. Y.	132
Lawrence, Mass.	1101	Atlantic City, N. J.	332	Côté St. Louis, Can.	126
Utica, N. Y.	895	Elmira, N. Y.	321	Jacksonville, Ill.	122
Des Moines, Iowa	873	Passadena, Cal.	314	Detroit, Mich.	115
Poughkeepsie, N. Y.	721	Morristown, N. J.	304	Attleborough, Mass.	114
Lowell, Mass.	668	Orange, N. J.	292	Oakland, Cal	110
Manchester, N. H.	635	Columbus, Ga	275	Fort Wayne, Ind.	109
Philadelphia, Pa	612	Chicago, Ill	273	Binghamton	106
St. Louis, Mo	604	Fitchburg, Mass.	271		
Montreal, Can.	596	St. Joseph, Mo.	271		

56,789

WATER METERS SOLD

To 67 Cities and Towns, an average of 848 Meters in each place.

These Meters are not SAMPLES or sent out on APPROVAL, but are SOLD to these WATER DEPARTMENTS.

252 BROADWAY, NEW YORK.

JUNE, 1890. **JOHN C. KELLEY, President.**

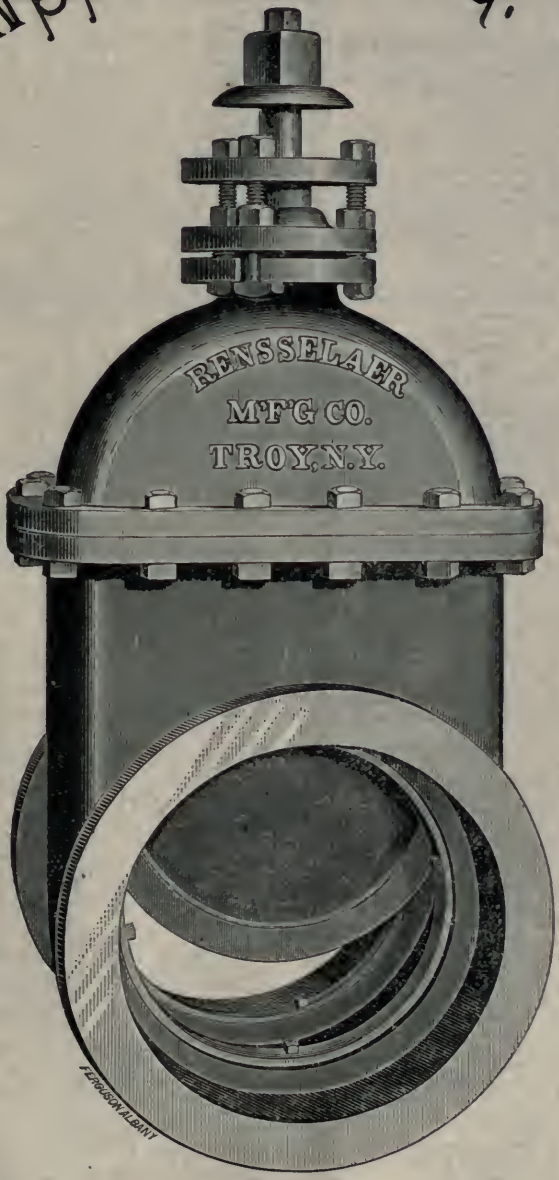
DIRECTORY OF WATER-WORKS SUPERINTENDENTS, SECRETARIES, ENGINEERS AND CONTRACTORS.

(The numbers following each name refer to the page on which the name appears.]

SUPERINTENDENTS.

Abell, Geo. M., Dunkirk, N. Y.... 141
Abendroth, E. W., Lexington, Mo.... 560
Acting, P., Waterville, N. Y..... 190
Adams, Anthony, Staff'rd Sp'gs, Conn 121
Adams, A. S., Hyde Park, Mass..... 59
Adams, Chas., Cheboygan, Mich 408
Adams, Jas., Logan, Utah..... 646
Adams, W., Nipomo, Cal 625
Aldrich, A. J., Lincoln, Ill 447
Alexander, Henry, Columbia, S. C.... 320
Alexander, W. A., Wilkinsburgh, Pa. 284
Alexander, W. R., Clarksb'gh, W.Va. 312
Alguire, J. J., E. Tawas, Mich..... 410
Allen, A., Milton, Ore. 612
Allen, G. E., Medina, N. Y..... 160
Allen, H. F., Saginaw, Mich..... 427
Allen, H. W., Redlands, Cal..... 630
Allen, Jas. K., Fresno, Cal..... 619
Allen, Johnson, Johnstown, Pa..... 242
Allen, W. H., Clinton, Mo 555
Allison, F. W., Salem, O..... 380
Allison, Geo. A., Burlington, N. J.... 200
Allis, Solon M., Malden, Mass..... 66
Alstulund, Fred, Moline, Ill..... 449
Ambrose, F. W., Urbana, O..... 384
Amiss, L. P., Baton Rogue, La..... 342
Ammon, J. M., Udall, Kans..... 524
Andrews, M. L., Arkansas City, Kan. 505
Andrews, R. N., Hamilton, O..... 371
Andrews, W. G., Plankington, So.Dak 543
Angier, G. W., Titusville, Pa..... 278
Anthony, C. F., Drownville, R. I..... 97
Appleby, G. O., Sumner, Wash..... 607
Arbuckle, B. P., Highlands, Col..... 594
Archer, M. C., Crestline, O..... 367
Archible, F. A., Concord, N. C..... 315
Armsbury, F. C., Wichita, Kan..... 525
Armstrong, A. B., Smethport, Pa..... 275
Armstrong, Ed., Allegheny, Pa..... 218
Armstrong, F., Council Grove, Kan.. 510
Armstrong, Milton, Milford, Pa..... 251
Atwater, I., Canton, Ill..... 435
Ayers, Jno. J., Portsmouth. N. H.... 25
Aylward, Jno., Livermore, Cal..... 621
Ayres, Jr., S., Bound Brook, N. J.... 199
Babbidge, P. F., Keene, N. H..... 20
Babcock, S. E., Little Falls, N. Y. 157
Bacon, E. L., Beaumont, Tex 571
Bagnell, R. W., Plymouth, Mass. ... 76
Baillarge, C., Quebec, P. Q..... 661
Baker, E. E., Kewanee, Ill..... 447
Baker H. F., Bellevue, Ida. 618
Baldwin, W. D., Groton, N. Y..... 149
Ball, E. D., Spartanburgh, S. C..... 320
Ballentine, David, Andes, N. Y. 129
Ballou, C. A., Danville, Va..... 301
Barbour, W. D., South Boston, Va.... 309
Barcus, W. J., Pasadena, Cal..... 627
Bardill, John F., Nazareth, Pa..... 254
Baric, Geo., Pinconning, Mich..... 425
Barker, Wm. E., Sidney, N. Y..... 182
Barnard, D. G., Haddonfield, N. J.... 202
Barnes, F. B., Oshkosh, Wis..... 471
Barnes, M. L., So. Hadley F's, Mass.. 82
Barney, Wm. H., Milford, Mass..... 69
Barns, Everett, Westerly, R. I..... 104
Barry, S. J., Ridgway, Pa 268
Bartholomew, Dana, Ansonia, Conn.. 106
Bartlett, C. L., Carthage, Mo..... 555
Bartram, I. N., Sharon, Conn..... 119
Bassett, G. G., State Centre, Ia..... 192
Bassett, Jno., Weatherford, Tex..... 585
Bassett, Philip J. H., Dover. N. J.... 201
Bassett, Thos., Collingwood, Ont.... 666
Bates, S. D., Lewisburgh, Pa 246
Bates, Thos. K., Webster, Mass..... 89
Beach, Geo. H, Olathe. Kan..... 520
Beall, D. C., Bucyrus, O..... 362
Beals, Jos E., Middleborough, Mass.. 69
Beardall, W., Sanford, Fla..... 330
Bechtel, I. P., Tremont, Pa. 279
Beebe, C. A., Hutchinson, Kan..... 515
Beebe, W. D., Redfield, So. Dak..... 543
Beers, G. G., New Berlin, N.Y..... 162
Bell, Jas. A., St. Thomas, Ont..... 675
Bell, J. H., Adrian Mines, Pa. 217
Bell, L. S., Salisbury, Md..... 296
Bemus, J. E., Boulder, Col..... 588
Bend, J. S. Pennington, N. J..... 211
Benishek, A., Negaunee, Mich..... 423
Bennett, C. E., Ticonderoga, N. Y.... 185
Bennett, G. N., Pierce City, Mo..... 561
Bennett, John A., Springvale, Me.... 14
Bennett, J. M., Pocatello, Ida..... 649
Bennett, S. A., Canaan, Conn..... . . 109
Bennett, Thos. H., Oswego, N. Y..... 171
Bennett, Wm., Augusta, Ga..... 323
Bennett, Wm., Superior, Wis..... 474
Bent, R., Cochituate, Mass..... 50
Berg, M., Spearfish, So. Dak... 544
Berriman, Peter, Springfield, Ill..... 457
Betts, A. L., North Tarrytown, N. Y. 168
Bevan, Sam'l., Tacony, Pa.... 277
Biays, W. H., Bunker Hill, Kas..... 507
Bierbower, Wm., Newaygo, Mich.... 423
Bigelow, A. D., Ft. Benton, Mont.... 552
Bigler, H. F., Clearfield, Pa..... 228
Bird, Chas., Fortress Monroe, Va..... 301
Bird, D. N., Belfast, Me..... 4
Birdsall, F. W., Sacramento, Cal..... 615
Birely, S. M., Mechanicstown, Md 295
Bishop, E. H., Wahpeton, N. Dak.... 548
Bishop, Justus, Archbald, Pa 219
Bishop, W. L., Kentville, N. S..... 654
Blackburn, M. A., Salem, S. Dak .. 543
Blaine, Richard, Brampton, Ont..... 664
Blaksiee, Chas. A., Mauch Chunk, Pa 247
Bliss, C. E., Visalia, Cal..... 640
Bliss, Geo. F., Eureka, Cal..... 644
Blum, Jr., Philo B., Chatham, N. Y 136
Bodder, Chas., Bethlehem, Pa..... 222
Boeckh, Ed., Lansing, Ia..... 485
Boehmer, Chas., Cedar Falls, Ia..... 478
Boland, A., Morganza, Pa..... 258
Bolling, Chas. E., Richmond, Va..... 307
Bolin, W. E , Circleville, O..... 364
Bolyer, T. O , Kingston, Ont..... .. 668
Bolton. E. B., Gaylord. Mich..... 412
Bond, Chester R., Lenox, Mass..... 62
Boomer, L. E., Las Animas, Col..... 595
Boon, J. B., Salem, Va..... 309
Borden, I. L., Alameda, Cal..... 615
Borst, Jas. N., Cobleskill, N. Y.... . 137
Bowen. M. C., Tidioute, Pa..... 277
Bowers, M. F., Manitou Sp'gs., Col... 597
Bowman, H. J., Berlin, Ont..... 661
Bowman, J. F., Walla Walla, Wash.. 607
Bowne, Jno. D., Jamesburg, N. J..... 209
Boyce, R. B., Washington, Ind..... 401
Brackett, Dexter, Boston, Mass..... 11
Bradley, H. S., Manchester, Va..... 305
Brady, John G., Worcester, Mass'.... 95
Bragden, H. G., Canajoharie, N. Y... 134
Brainard, E. D., Great Barrington, Mass..... 55
Brand, Julius A., Norwich, Conn..... 118
Bredin, J. R., Rogers. Ark..... 569
Brewster, C. A., Addison, N. Y..... 126
Brice, I. N., Troy, O..... 383
Bridge, Henry, Detroit, Mich..... . 409
Brigden, W. W., Battle Creek, Mich.. 401
Brigham, Perry, Ulysses, Pa..... 280
Brinekerhoff, A. S., Fishkill-on-the-Hudson, N. Y..... 142
Brinkley, F. T., Roanoke, Va..... 308
Brinsmade, D. S., Birmingham, Conn. 120
Broatch, J. C., Middletown, Conn.... 114
Bronson, S. E , Mazo Manie, Wis.... 469

RENSSELAER MFG. CO.



TROY, N. Y.

Superintendents.
Brooks, J., Lansingburgh, N. Y..... 156
Browere, Edw. A., Lyons, N. Y..... 159
Brown, A., Fairbury, Ill..... 442
Brown, C. S., Glenwood, Minn..... 498
Brown, Geo. H., Pittsburgh, Pa..... 265
Brown, Geo. H., Longmont, Col..... 596
Brown, J. N., Farwell, Mich..... 411
Brown, John H., Bristol, N. H..... 16
Brown, Milton A., Perth Amboy, N.J. 212
Brown, W. F., Minneapolis, Kan..... 519
Bruce, D. H., Syracuse, N. Y..... 184
Brundige, Wm. H., Florence, Ala..... 335
Brush, Chas. B., Hoboken, N. J..... 203
Bryan, C. F., Parkersburgh, W. Va... 313
Bryan, Malcolm W., Crewe, Va..... 301
Bryan, M. W., Bluefield, W. Va..... 311
Buchanan, J. J., Johnstown, N. Y.... 155
Buck, Robt., Watsontown, Pa..... 282
Buckley, Ralph, Media, Pa..... 249
Bucknan, Geo. A. P., Norwood, Mass.. 75
Bull, W. B., Quincy, Ill..... 454
Bullard, Dexter, Spencer, Mass..... 82
Bunker, Theo., Hayward, Wis..... 465
Bunn, H. B., Rahway, N. J..... 213
Bunn, Wm. S., Sturgis, Mich..... 428
Burke, Jas. E., Princeton, N. J..... 213
Burchill, Alex., Fredericton, N. B.... 650
Burnett, M., Paducah, Ky..... 358
Burney, C. B., Milford, N. H..... 23
Burnham, Albert S., Revere, Mass... 79
Burnham, Wm., Rogers Park, Ill.... 455
Burnie, Jas., Biddeford, Me..... 4
Butler, Chas. S., Durango, Col..... 592
Butler, Jno. G., Tybee, Ga..... 327
Cadwalader, Chas., Red Bluff, Cal.... 629
Cady, Jno. R., Roscommon, Mich..... 426
Cahill, S. A., Manistee, Mich..... 420
Cameron, W., Memphis, Tenn..... 348
Camp, Geo. L., Beaver Dam, Wis.... 462
Campbell, C. H., Ocala, Fla..... 329
Campbell, D. F., Traverse City, Mich. 429
Campbell, J. F., Eastport, Me..... 7
Campbell, W. A., Tampa, Fla..... 331
Campbell, W. H., Larchmont, N. Y.. 156
Canfield, A. W., Santa Barbara, Cal. 636
Cannon, S. M., Terrel, Tex..... 583
Cappelman, A., Santa Cruz, Cal..... 636
Carpenter, C. W., Andover, So. Dak. 540
Carpenter, Geo. W., Albany, N. Y.... 128
Carroll, Arnold S., Hobart, N. Y..... 151
Carter, Jacob E., Trenton, N. J..... 215
Cass, H. G., Aurora, Neb..... 527
Caton, J. D., Ottawa, Ill..... 451
Cave, A., Missoula, Mont..... 553
Chadbourne, E. J., Randolph, Mass. 78
Chadwick, Wm. B., Vincennes, Ind.. 400
Chaffee, J. C., Lee, Mass..... 61
Chamberlain, A. E., Dalton, Mass.... 51
Chamberlain, M., Prattsville, N. Y... 175
Chambers, John T., Escondido, Cal... 618
Chandler, G. H., Kalamazoo, Mich.... 418
Chapin, F. L., Southbridge, Mass..... 81
Charles, S. A., Lexington, Ky..... 355
Chase, F., Hanover, N. H..... 19
Chase, Geo. F., Taunton, Mass..... 86
Chase, H. S., Great Falls, N. H..... 19
Chase, John C., Wilmington, N. C.... 318
Chase, W. W., Turner's Falls, Mass.. 87
Chatham, J., Iowa City, Ia..... 485
Chew, A. R., Lockhart, Tex..... 579
Chew, Jr., T. J., St. Joseph, Mo..... 562
Childs, W. H., Manchester, Conn..... 113
Chopp, C. J., Otsego, Mich..... 424
Chrisman, G. R., Eugene City, Ore... 610
Church, Jno. S., La Conner, Wash.... 604
Clark, A. C., Wytheville, Va..... 310
Clark, D., Hazleton, Pa..... 239
Clark, D. M., Elyria, O..... 370
Clark, Ezra, Hartford, Conn..... 112
Clark, F. T., Albion, N. Y..... 128
Clark, Geo., Waterloo, N. Y..... 189
Clark, H., Merritton, Ont..... 670
Clark, J. M., Northampton, Mass.... 73
Clark, J. W. Tombstone, Ariz..... 643
Clark, O. B., Asbtabula, O..... 360
Clark, Thos. B., Poultney, Vt..... 30
Cleaveland, W. F., Brockton, Mass.. 43
Clemens, A. H., W. Toronto Junc., Ont. 679
Clemens, Geo. S., Pottsville, Pa..... 236
Cleveland, J. A., Ely, Minn..... 497
Clowell, B. F., Weatherly, Pa..... 283
Cloud, B. W., Woodbury, N. J..... 216
Cloud, J. A., Jacksonville, Fla..... 318
Coburn, A., Anderson, Ind..... 388
Cochran, R. L., Nahant, Mass..... 69
Codd, Wm. F., Nantucket, Mass..... 70
Coe, H. C., Hood River, Ore..... 611
Coe, L. E., Sauk Centre, Minn..... 502
Coffin, G. H., Ashbury Park, N. J..... 195
Coffin, H. W., Tuscarora, Nev..... 645
Coffin, Isaac T., Dutch Flat, Cal..... 618
Coggeshall, R. C. P., N. B'dford, Mass. 72
Cole, Ira, Warrensburgh, N. Y..... 188
Coleman, G. H., Portsmouth, Va., 307, 309
Coll, H., Mt. Pleasant, Pa..... 253
Collins, H. B., Murfreesboro, Tenn.. 348
Collins, Wm., North Muskegon, Mich. 424
Comstock, Theo. S., Rome, N. Y..... 178
Conant, H. W., Gardner, Mass..... 54
Conant, Whitney. Long Branch, N. J. 206
Conaway, Y. T., Canon City, Col..... 569
Congdon, J. L., East Greenwich, R. I. 98
Connell, M. A., St. Hyacinthe, P. Q.. 662
Conyell, Torkett, Lambertville, N. J. 205
Cook, Byron J., Woonsocket, R. I.... 106
Cook, J. S., Blair, Neb..... 528
Cook, R. C., Chattanooga, Tenn..... 345
Cooke, J. B., Colusa, Cal..... 618
Cooke, J. S., Petersburgh, Va..... 306
Coon, C. P., Hudson, Wis..... 466
Cooper, Frank, Charleston, Ill..... 436
Cooper, Geo. F., Xenia, O..... 386
Cooper, H. R, Thompsonville, Conn.. 122
Corbet, Dr., Orangeville, Ont..... 672
Corbett, M. W., Aurora, Ill..... 432
Corey, T. N., Bryan, Tex..... 572
Corley, Jno. R., Mexia, Tex..... 580
Corning, B. H., Littleton, N. H..... 21
Cornwall, P. B., Belling'm Bay, Wash. 603
Corrie, Jno., Stratford, Ont..... 676
Corrin, Rob't, Miller, S. Dak..... 541
Corsett, Smith D., Knox, Pa..... 243
Cosgrove, A. M., Grand Haven, Mich 413
Costa, Paul, Austin, Pa..... 220
Cotter, H., Toledo, O..... 383
Cotter, Jno. A., Galveston, Tex..... 577
Cotton, C. R., Gananoque, Ont..... 667
Couch, R. N., Gt. Barrington, Mass.. 55
Coursey, T. F., Plattsmouth, Neb..... 535
Coutu, Gordien, Berthier, P. Q..... 657
Covell, L. T., Shelburne Falls, Mass.. 81
Cox, John L., Bridgetown, N. S..... 652
Craig, B. E., Ellensburgh, Wash..... 603
Craig, C., Oskaloosa, Ia..... 490
Craig, Wm., Duluth, Minn..... 497
Cramer, C. H., New Brunswick, N. J. 209
Crawley, Jno. B., Shreveport, La..... 343
Crayfort, E. Salem, Ind..... 398
Crennel, Robt., Honcoye Falls, N. Y.. 151
Crilly, P. F., Woburn, Mass..... 94
Crim, J. P., Richfield Springs, N. Y.. 176
Crocker, Jno. P., Dover, Me..... 6
Crocker, J. W., Rockland, Me..... 12
Crop, L. C., Pleasanton, Kan..... 522
Crosby, F., Montgomery, Ala..... 337
Cross, L. B., Bath, N. Y..... 131
Crossman, A. F., No. Clarendon, Pa.. 256
Cullum, Geo. S., Meadville, Pa..... 249
Culver, E. E., Winsted, Conn..... 125
Culver, S. B., Louisiana, Mo..... 550
Cummings, A. F., Vineyard Haven, Mass..... 87
Cunliffe, L. H., Garden City, N. Y.... 145
Cunningham, E., La Fayette, Ind..... 393
Cunningham, J. M., E. Brady, Pa.... 231
Cunningham, W. B., Trinidad, Col... 599
Cunningham, W. W., Clinton, Ia..... 480
Cunningham, W. W., Huntington, W. Va..... 312
Currier, Orlando, Hallowell, Me..... 8
Curtis, F. M., Richmond, Ind..... 397
Curtis, W. J., Alton, Ill..... 432
Cushman, A. H., Ellsworth, Me..... 7
Dailey, W. E., Belleville, Kan..... 506
Dale, Frank, Foxburgh, Pa..... 235
Dalziel, Chas., Charlottetown, Prince Edward Island..... 656
Dane, Wm., West Brookfield, Mass.. 90
Darling, Edwin, Providence, R. I..98, 101
Darrough, S. A., Anthony, Kan..... 505
Davenport, E. F., Springvale, Me..... 14
Davidson, E. F., Peabody, Kan..... 521
Davidson, Jas, Central City, Col..... 589
Davis, C. B., Stoughton, Wis..... 474
Davis, E. K., Cherry Vale, Kan..... 508
Davis, F. A. W., Indianapolis, Ind... 392

HAYS MANUFACTURING CO.

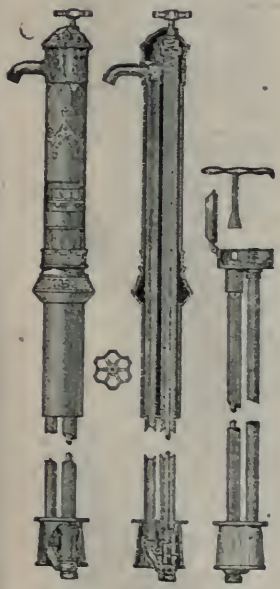
(Successors to **JARECKI-HAYS & CO.**)

ERIE, - PENNA.

MANUFACTURERS OF

WATER AND GAS COMPANIES' SUPPLIES

BRASS GOODS.



SPECIALTIES:

Extension Service Boxes,

Corporation Stop

Cocks,

Service Cocks,

McNamara Hydrants

AND

Street Washers.

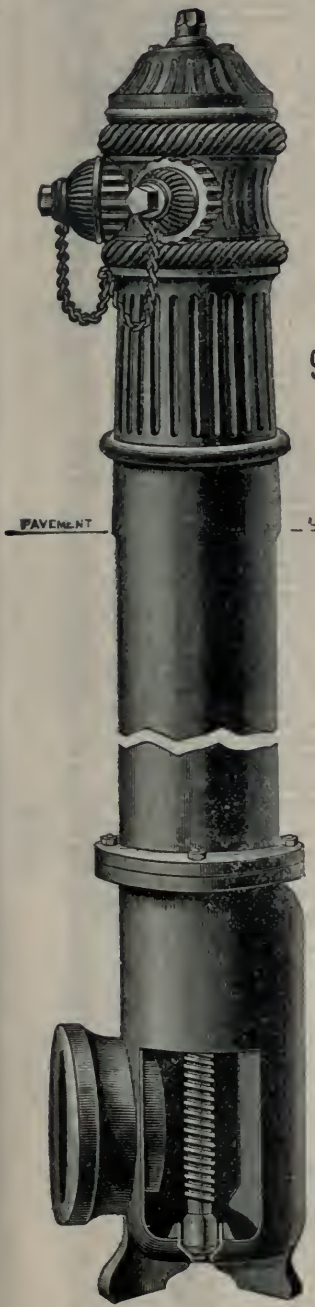
MALLEABLE AND CAST-IRON FITTINGS.

SEND FOR PRICE LIST.

Superintendents.

Davis, F. H., New Rochelle, N. Y..... 163
Davis, J M., Rutland, Vt..... 31
Davis, W. E., Sherburne, N. Y..... 181
Davis, Wm. M., Northfield, Vt..... 30
Davison, C. M., Pittsburgh, Kans.... 522
Day, F. B., Salinas, Cal..... 632
Dayton, Jno., Greenwich, Conn.. 111, 174
Deakin, Geo. F., Waukesha, Wis..... 475
Decker, J. H., Salina, Kan..... 522
DeGraff, A. H., Amsterdam, N. Y.... 128
Deisbach, C., Lewisburgh, Pa..... 246
Demorest, G. F., Lapeer, Mich..... 419
Denman, A. N., Des Moines, Ia..... 482
Dennis, W. A., Waterford, N. Y..... 188
Denny, C. P., Marysville, Mo..... 560
Depuy, Geo., Berwick, Pa..... 221
Derby, G. M., West Point, N. Y..... 191
De Sancha, C. C., Arkansas City, Ark. 567
Deschamps, L., Lake Linden, Mich.... 418
Deyer, M., Allegan, Mich..... 403
Dickinson, Wm. G., National City, Cal 624
Diehl, C. H., Westfield, Mass..... 91
Dietrick, Calvin, 52 B'way, N. Y. City, N. Y..... 183
Diffenbaugh, C. H., Tyrone, Pa..... 280
Diven, J. M., Elmira, N. Y..... 142
Dixon, Wm., Mt. Pleasant, Mich..... 422
Dixon, Wm., Muskegon, Mich..... 423
Dobson, M., So. Oil City, Pa..... 256
Doherty, Jno., Rhinelander, Wis..... 473
Dolan, Edw., Troy, N. Y..... 186
Dole, H. N. P., Delaware, O..... 368
Donald, Mark L. M., Santa Rosa, Cal. 636
Donelson, V. E., Templeton, Cal..... 638
Dorn, G. W., Chico, Cal..... 617
Dorsey, J. J., Grass Valley, Cal..... 620
Dotten, Wm. T., Winchester, Mass... 94
Douglas, A. J., Waco, Tex..... 585
Douglas, Henry, Boyertown, Pa..... 223
Douglas, H. F., Cape May City, N. J.. 200
Dowd, Thos., Orange, N. J..... 210
Downs, Isaac C., Lewiston, Me..... 9
Doyle, F. P., Petaluma, Cal..... 628
Doyle, Geo., Greenport, N. Y..... 149
Drake, Chas. W., Etna, Pa..... 234
Drake, W. A., Pueblo, Col..... 595
Driggers, M. N., Cartersville, Ga..... 324
Drummond, F., Drummond, Wis..... 463
Dudley, Chas., Jackson, Miss..... 340
Duff, J. W., Old Orchard, Me..... 10
Dunbar, E. L., Bay City, Mich..... 405
Duncan, J. S., Au Sable, Mich..... 404
Dunham, Sam'l., Little Valley, N. Y. 158
Dunlap, F. M., Telluride, Col..... 599
Dunlap, Jno. B., Meriden, Conn..... 113
Dunn, J. M., Le Mars, Ia..... 486
Dunn, Wm. A., Morristown, N. J.... 207
Dyer, Chas., Raton, N. M..... 602
Eason, W. E., Brattleboro, Vt..... 28
Eastabrook, E. R., Hoosick Falls, N. Y. 152
Eaton, C. A., Kent, Conn..... 112
Ecoff, Jos., McKeesport, Pa..... 247
Edwards, B. F., Reed City, Mich..... 426
Edwards, Jno., Jefferson City, Mo.... 557
Egan, ——, Windsor Locks, Conn..... 125
Eggleston, W. H., Warsaw, Ind..... 401
Ellegood, Seth G., Sing Sing, N. Y... 182
Elliot, Chas., San Francisco, Cal..... 634
Ellis, E. H., Port Jervis, N. Y..... 174
Ellis, R. N., Jacksonville, Fla..... 329
Elmer Howard, Sayre, Pa..... 270
Engelhard, E. B., Raleigh, N. C..... 317
Evans, Fred. W., Cote Saint Antoine, Que..... 657
Evans, H. E., York Village, Me..... 15
Fahs, G. W., Conway Springs, Kan... 509
Fairbank, W. G., Middletown, Conn. 109
Fairbarn, A., Berthoud, Col..... 587
Fales, F. L., Vassar, Mich..... 429
Fales, Henry M., Tonawanda, N. Y.. 185
Farley, J. C., Randolph, Neb..... 535
Farren, J. F. M., Bluffton, Ind..... 388
Fasig, Wm. A., Columbia, Pa..... 228
Fassett, A. L., White Plains, N. Y.... 192
Fecker, L., Kenton, O..... 372
Felter, D., Binghamton, N. Y..... 132
Felter, R. H., Austin, Tex..... 571
Ferguson, F. D., Streator, Ill..... 458
Ferguson, Jno., Sonora, Cal..... 637
Fern, Wm., Worcester, N. Y..... 192
Ferrier, Wm. E., Conshohocken, Pa.. 229
Fetz, Jno., Evansville, Ind..... 390
Fillman, S. P., Redding, Cal..... 629
Fish, J. B., Scranton, Pa..... 271
Fisher, A. B., Caribou, Me..... 6
Fisher, H., Freeland, Pa..... 236
Fisher, M. M., Mishawaka, Ind..... 395
Fisher, R. J., Athens, Tenn..... 344
Fisher, Wm. I., Flint, Mich..... 411
Fisher, W. O., Lockport, Ill..... 448
Fisk, J. A., Ansonia, Conn..... 106
Fitch, E. D., Pulaski, N. Y..... 175
Fitch, Geo., Sharpsburgh, Pa..... 273
Fittz, Geo. B., Attleborough, Mass... 38
Fitzgerald, M. G., Denison, Tex..... 575
Fitzpatrick, W. F., Liberty, Va..... 303
Flanagan, W. M., Galesburg, Ill..... 444
Flate, P., Del Rio, Tex..... 575
Flint, Joseph A., San Diego, Cal..... 632
Floyd, Jno., Moberly, Mo..... 551
Foge, A. S., Wellsville, O..... 385
Fogle, C. A., Salem, N. C..... 317
Forbes, F. F., Brookline, Mass..... 44
Forbes, M., Greensburgh, Pa., 230, 237, 241
Ford, Jno. E., Newton, Kan..... 519
Foster, E. P., Ventura, Cal..... 632
Foster, Joel, Montpelier, Vt..... 30
Fournia, Chas., Midland, Mich..... 421
Fowler, C. E., Poughkeepsie, N. Y.... 175
Fox, C. J., Cedar Rapids, Ia..... 479
Fox, Geo. H., Kittanning, Pa..... 252
Frailey, Edw. F., Lancaster, Pa..... 244
Franki·h, C., Ontario, Cal..... 626
Freeman, E. J., Audubon, Ia..... 477
Freeman, Geo. H., Presque Isle, Me. 12
French, M. C., Braintree, Mass..... 42
French, W. E., Galena, Ill..... 443
Frierson, A. S., Columbus, Miss..... 340
Fritts, W. A., Trenton, Mo..... 565
Fritz, D. E., Lima, O..... 373
Fritz, Jonathan, Emaus, Pa..... 233
Frizzell, Wm., Cascade, Col..... 589
Frost, Edw., Colorado Springs, Col.. 589
Fry, D. C., Jacksonville, Ill..... 445
Fuller, L. T., Calvert, Tex..... 573
Futze, P. B., Concord, N. C..... 315
Fyler, O. R., Torrington, Conn..... 123
Gailey, S. A., Altoona, Pa..... 219
Gallagher, Sam'l, Langhorne, Pa..... 244
Gallehan, J. H., Marion, Va..... 305
Galligas, Juan, Mission San Jose, Cal. 623
Gamble, Jno., Port Hope..... 674
Gamwell, Jno. H., Palmer, Mass..... 75
Gardiner, J. M., Phœnix, Ariz..... 642
Gardner, H. E., Eldora, Ia..... 482
Gariepy, J. A., Longueuil, P. Q..... 659
Garren, G. W., Paso Robles, Cal..... 627
Gates, A. R., Helena, Mont..... 553
Gay, F. D., Boone, Ia..... 477
Gee, Decatur, Canastota, N. Y..... 135
Genest, Ludger, Hull, P. Q..... 658
George, Frank, Bartlett, N. H..... 16
Gerber, J., Fremont, Mich..... 412
Gillette, F. N., Fairhaven, Wash.... 604
Gilpin, E. E., Washington, Mo..... 566
Gilson, T. G., Knoxville, Ia..... 485
Givens, J. W., Selma, Cal..... 637
Glashan, T. M. W., Palestine, Tex... 581
Gleason, Jno. F., Joliet, Ill..... 446
Glenn, P. D., McMinnville, Ore..... 611
Glore, W. H., Covington, Ky..... 353
Glover, D. F., Bayfield, Wis..... 462
Glover, C. M., Mt. Pleasant, Ia..... 488
Glover, C. W., Joplin, Mo..... 558
Gober, W. H., Brunswick, Ga..... 324
Golden, D., Freeport, Pa..... 236
Goodall, E. M., Sanford, Me..... 13
Goodrich, G. A., Colfax, Ia..... 480
Goodrich, H. P., Lebanon, N. H.... 21
Goodrich, O. L., Granville, N. Y..... 147
Gorman, Wm. H., Annapolis, Md... 290
Gould, A. H., Ashland, Neb..... 527
Gow, R. M., Medford, Mass..... 68
Graham, T. G., Cucamonga, Cal..... 618
Grannis, S. E., New Haven, Conn..... 115
Grant, E. M., Morgantown, W. Va... 313
Graves, J. D., Monticello, Ia..... 488
Graves, J. S., Meyersdale, Pa..... 250
Graves, Sam'l S., Geneva, N. Y..... 146
Graves, Wm., Corvallis, Ore..... 610
Gray, Geo. R., Newark, N. J..... 209
Gray, L. E., Albany, Ore..... 609
Gray, T. W., Whitewater, Wis..... 476
Green, E. O., Manitowoc, Wis..... 468
Green, W. M., Kearney, N. J..... 204
Greenfield, Jno., Rochester, N. H.... 25

LUDLOW
VALVE MANUFACTURING CO.



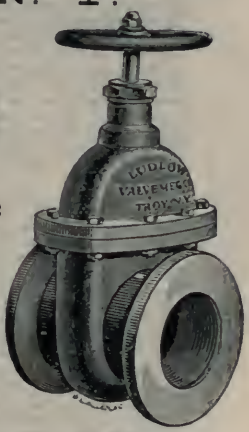
OFFICE AND WORKS:

938 to 954 River St. and 67 to 83 Vail Ave.,

TROY, N. Y.

VALVES

Double and Single Gate, 1-2 in. to 48 in., outside and inside Screws, Indicator, etc., for Gas, Water, Steam and Oil



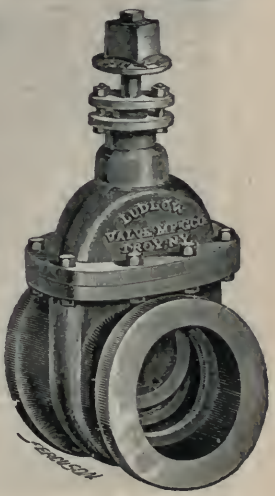
Check Valves,

Foot Valves,

Valve Boxes,

Yard, Wash &

Fire Hydrants.



Send for Circular.

Superintendents.

Greenley, E. J., Black River Falls, Wis..... 462
Greenman, J. N., Austin, Minn..... 495
Greetham, H. W., Orlando, Fla..... 329
Grier, T. J., Deadwood, So. Dak..... 540
Griffin, Jno. D., Frankfort, Ky..... 353
Griffin, Jno. F., Lock Haven, Pa..... 246
Griffith, J. C., Anamosa, Ia..... 477
Griffiths, J. J., Towanda, Pa..... 278
Grose, Wm. R., Rockland, Mass..... 79
Gross, A., McPherson, Kan..... 518
Gross, J. F., Welland, Ont..... 679
Guernsey, A. D., Independence, Ia..... 484
Guernsey, Geo. A., Canton, Pa..... 225
Guy, Jas. P., Carbonear, N'f'd..... 656
Gyer, Harry, Manheim, Pa..... 248
Haas, A. F., Adrian, Mich..... 403
Haddon, S. W., Marine City, Mich... 420
Hahn, C. N., Frederick, Md..... 294
Hahn, T., Columbus, Tex..... 573
Hale, J., Lyons, Mich..... 420
Hall, Chas., Oconto, Wis..... 471
Hall, C. H., Ishpeming, Mich..... 417
Hall, F. E., Quincy, Mass..... 78
Hall, O. L., Wolcottville, Ind..... 401
Hamel, O. Z., Three Rivers, P. Q..... 663
Hamerer, Louis M., Mercer, Pa..... 250
Hamilton, A. W., Ann Arbor, Mich.. 404
Hamilton, E., Chicago, Ill..... 439
Hamilton, James, Downington, Pa... 230
Hamilton, John, Stamford, N. Y..... 183
Hamilton, W., Toronto, Ont..... 678
Hamilton, W. S., Youngstown, O..... 386
Hancock, J. C., Springfield, Mass..... 84
Hand, Frank L., Philadelphia, Pa.... 263
Hanley, P. M., Ft. Madison, Ia..... 483
Hanna, J. A., Clay Centre, Kan..... 508
Hanna, R. J., Franklin, Pa..... 235
Hannah, J. E., Winnipeg, Man..... 631
Hardenock, Jos., Ashland, Pa..... 219
Hardy, Jno. D., Holyoke, Mass..... 58
Harkness, Ed., Thermalito Colony, Cal..... 638
Harmes, G. R., Belleview, Ky..... 352
Harper, Wm. B., Reading, Pa..... 268
Harrigan, D. J., Danvers, Mass..... 51
Harrigan, P. J., Long Island City, N. Y..... 159
Harrington, Geo. W., Wakefield, Mass. 87
Harrington, W. K., Green Bay, Wis.. 464
Harris, D. A., New Britain, Conn..... 114
Harris, D. L., Mendota, Ill..... 448
Harris, Jas. B., Geneseo, N. Y..... 145
Harris, Jno. L., Moncton, N. B..... 651
Harrison, H. H., Stillwater, Minn.. .. 503
Harrison, Ward, Birdsborough, Pa... 222
Harvey, Barney., Chateaugay, N. Y.. 136
Harvey, Robt., Sherman, Tex..... 583
Haskell, Jno. C., Lynn, Mass..... 66
Haskell, Jno. O., Concord, Mass..... 50
Haskill, Jas., Walston, Pa..... 281
Haskins, Wm., Guelph, Ont..... 668
Hassman, H., Park Ridge, Ill..... 452
Hastings, S., Leavenworth, Kan..... 517
Hastings, V. C., Concord, N. H..... 17
Hatch, Jno. M., Pittsfield, Mass..... 76
Haupt, F. S., Frackville, Pa..... 235
Haven, Edw., Navasota, Tex..... 580
Hawkins, C. J., Americus, Ga..... 312
Hawkins, T. S., Hollister, Cal..... 621
Hay, J. J., Kyle, Tex..... 579
Hay, M. W., Batavia, N. Y..... 131
Hayes, J., Saint Johns, N'f'd..... 657
Hayes, Jas., Newark, Del..... 287
Hayes, Jno., Appleton, Wis..... 461
Hayes, W. K., Parsons, Kan..... 521
Hazleton, E. J., Kenosha, Wis..... 467
Head, G. R., Leesburgh, Va..... 303
Heath, H. M., Augusta, Me..... 6
Heath, W. P., Weir, Kan..... 524
Heemans, H. C., Corning, N. Y..... 139
Heebner, I. D., Lansdale, Pa..... 244
Heineke, F. A., Dodge City, Kan..... 510
Hellwig, A. A., Gloverville, N. Y..... 146
Henderson, Thos., Brazil, Ind..... 389
Henderson, Wilson, Peterborough, Ont 673
Henneberg, Chas., Ft. Plain, N. Y.... 144
Hennessy, Thos., Holden, Mass..... 49
Henreuex, P. L., Saint Johns, P. Q.. . 662
Henshaw, Geo. W., Winston, N. C.... 318
Hermany, Chas., Louisville, Ky..... 356
Hershaw, Jno., Madison, Neb..... 532
Hess, S. D., Shenandoah, Pa..... 273
Hewett, T., Kingston, Ont..... 669
Hewson, A. J., Cobourg, Ont..... 666
Heylett, H. N., Oscoda, Mich..... 424
Heywood, R. J., Texarkana, Tex..... 584
Higby, T. S., Fairfield, Ia..... 483
Higgins, H. W., Plainville, Conn..... 118
Hill, Albert F., Phenix, R. I..... 102
Hill, C. C., West Troy, N. Y..... 191
Hill, Wm. F., Dedham, Mass..... 52
Hinds, W. W., Madison, Ind..... 394
Hodelich, R., Boonville, Mo..... 554
Hoeflich, Jno. R., Waynesborough, Pa. 283
Holden, Horace G., Nashua, N. H.... 23
Holland, Jas. Frank, Houlton, Me.... 8
Hollenberger, J. M., Union Bridge, Md. 296
Holman, S. W., Durham, N. C..... 315
Holman, Sam'l W., Hillsborough Bridge, N. H..... 20
Holme, Richard, Denver, Col..... 591
Holmes, A. L., Grand Haven, Mich... 413
Holmes, H. F., No. St. Paul, Minn.... 500
Holmes, J. B., Lexington, Va..... 303
Holt, C. E., Chatham, Va..... 300
Holt, Jas. M., Skowhegan, Me..... 13
Hood, Chas, Burlington, Ia..... 478
Hoover, Jos., Connersville, Ind..... 389
Hopewell, J. C., Flemington, N. J..... 201
Hopkins, J. M., Mt. Pulaski, Ill..... 450
Hopper, Geo. E., Manhattan, Kans.... 518
Hornbeak, W. C., Springfield, Mo..... 565
Hornblower, J. C., Salem, N. J..... 214
Horner, A. F., Florence, Kan..... 511
Horner, F. M., E. St. Louis, Ill..... 441
Horner, S. H., Caldwell, Kan..... 508
Hotchkiss, C. M., Whitehall, N. Y.... 191
Houghton, E. L., Ft. Fairfield, Me.... 7
Howe, J. C., Janesville, Wis..... 467
Howe, J. S., Covington, Va..... 301
Howell, W. H., Oregon City, Ore..... 612
Howland, A. H., Boston, Mass.... 334,337
Howland, B. W., Tyler, Tex..... 584
Hoyt, T. J., Mt. Clemens, Mich..... 422
Hubbard, Jno. E., Montpelier, Vt..... 29
Hudler, Alfred, Kingston, N. Y..... 156
Hughes, M. B., Shickshinny, Pa..... 274
Hughes, W., Palmer Lake, Col..... 597
Hunt, A. B., Omaha, Neb..... 534
Hunt, J. S., Savanna, Ill..... 456
Hunt, Wm., Steubenville, O..... 382
Hurley, Chas. B., Tacoma, Wash..... 607
Huston, Sam'l, Oroville, Cal..... 626
Hutchings, W. S., Jermyn, Pa..... 241
Hutchison, D. P., Charlotte, N. C..... 315
Hyde, Jr., H. Nelson, Newton, Mass.. 72
Hyman, V. L., Hendersonville, N. C.. 316
Ingels, C. B., Nevada, Mo..... 561
Ingersoll, Geo. T., Schenectady, N. Y. 180
Inman, C. E., Menominee, Mich..... 421
Irish, P. E., Amherst, Mass..... 36
Irwin, W. C., Greenville, Tex..... 578
Jackson, F. W., Oak Park, Ill..... 451
Jackson, T., Oregon, Ill..... 451
Jacobs, W. W., Springer, N. M..... 602
Jacobus, D., Crookston, Minn..... 496
James, D., Loveland, Col..... 596
Jefts, Wm., Big Rapids, Mich..... 406
Jenness, A. R., Fryeburg, Me..... 7
Jeremy, R. W., Emporia, Kan..... 511
Johnson, Chas. H., Exeter, N. H..... 18
Johnson, W. H., Alpena, Mich..... 403
Johnson, W. Shaler, Chester, Pa..... 227
Johnston, Malcolm, Reynoldton, Pa.. 269
Johnston, W. A., Latrobe, Pa..... 245
Jones, B. F., Kansas City, Mo..... 559
Jones, Geo. L., Braddock, Pa..... 224
Jones, M. E., Gadsden, Ala..... 336
Jones, O. O., Keokuk, Ia..... 485
Jones, R. A., Spokane Falls, Wash.... 606
Jordan, F. M., Auburn, Me..... 1
Josel, F. E., Freeport, Ill..... 443
Joslyn, C. E., Barton Landing, Vt.... 27
Joyce, A. K., Bristol, Pa..... 224
Joyce, Geo., Beaver, Pa..... 220
Judson, Chas. A., Sandusky, O..... 381
Kalback, Jno. F., Blairsville, Pa..... 223
Karr, L., Yankton, So. Dak..... 545
Kastlin, J., West Burlington, Ia..... 493
Kear, Chas. R., Minersville, Pa..... 251
Kearns, Henry, Danville, Pa..... 230
Keasor, M. G., Tilton, N. H..... 25
Keating, E. H., Halifax, N. S..... 654
Keefer, Stephen, Hanover, Pa..... 238
Keirns, T. H., Bristol, Conn..... 109

WELL MADE GOODS AND LOW PRICES ARE BOUND TO BE RESPECTED.

H. MUELLER MFG. CO.

MANUFACTURERS OF

Water Tapping Machines,

Gas Pipe Tapping Machines,

Water Pressure Regulators,

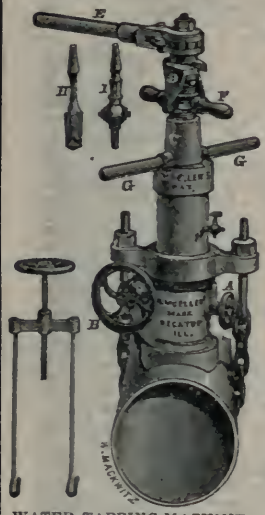
Corporation Stop Cocks,

Round Way Stop Cocks,

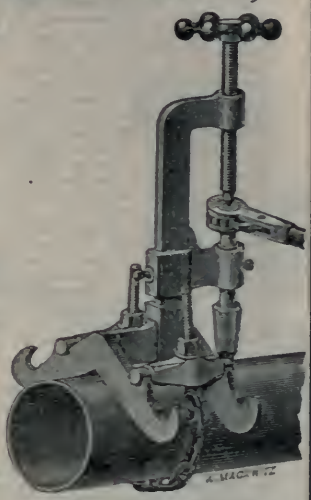
Stop and Waste Cocks,

Brass Water Connections,

Check and Waste Cocks; Etc., Etc.



WATER TAPPING MACHINE.



GAS TAPPING MACHINE.

UNEQUALLED IN EFFICIENCY.

SOLD UPON MERIT.

Our **TAPPING MACHINE** is acknowledged by everybody as the most complete and best machine in the market, and we have over 900 machines sold in the United States. We have on file in our office testimonials from all parts of the Union.

Mr. C. E. Gray, of the Gas and Water Works at Duluth, Minn., writes us as follows:

"Gentlemen: Your later improvements in Tapping Machines I very much like; nevertheless I have no fault to find with any one of the machines of the many I have purchased of you to supply the several Gas and Water Works that I have contracted for during the past seven years. Yours truly,

C. E. GRAY."

WHAT IS SAID OF OUR IMPROVED GAS TAPPING MACHINE.

DECATUR, ILL., March 1, 1890.

H. Mueller Mfg. Co., City.

"Gentlemen: I have been using one of your improved gas tapping machines for the past year, and must say that I am so well pleased with it that I would not use an old style—Crow Hook—if I could buy it for $1."

Yours very respectfully,

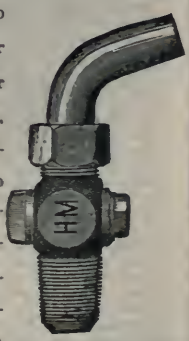
R. J. STRATTON,

Supt. Decatur Gas Light and Coke Co.

WATER PRESSURE REGULATOR.

We have the most encouraging reports from our **WATER PRESSURE REGULATOR,** which is the best in the market. By the use of this Regulator a steady and uniform pressure from 20 to 30 pounds, as may be desired, can be obtained in any building, notwithstanding a fire-pressure of 120 pounds or more on the mains. In a city of Pennsylvania it is successfully used under a steady pressure of 165 pounds.

We are now prepared to furnish the Mueller Corporation Stop Cock for use with Hexagon Plug, the same as they have always been made up to this season. Also the new style used with screw plugs. All cocks manufactured by us are guaranteed to be perfect in every respect.



NO. 2 CORPORATION STOP COCK.

CORRESPONDENCE SOLICITED.

Prices furnished on application and a liberal discount to the trade.

WRITE FOR CIRCULARS.

H. MUELLER MFG. CO.

Office 222 E. Main St.

Factory, 111 to 117 State St., Decatur, Ill.

MADE UPON HONOR.

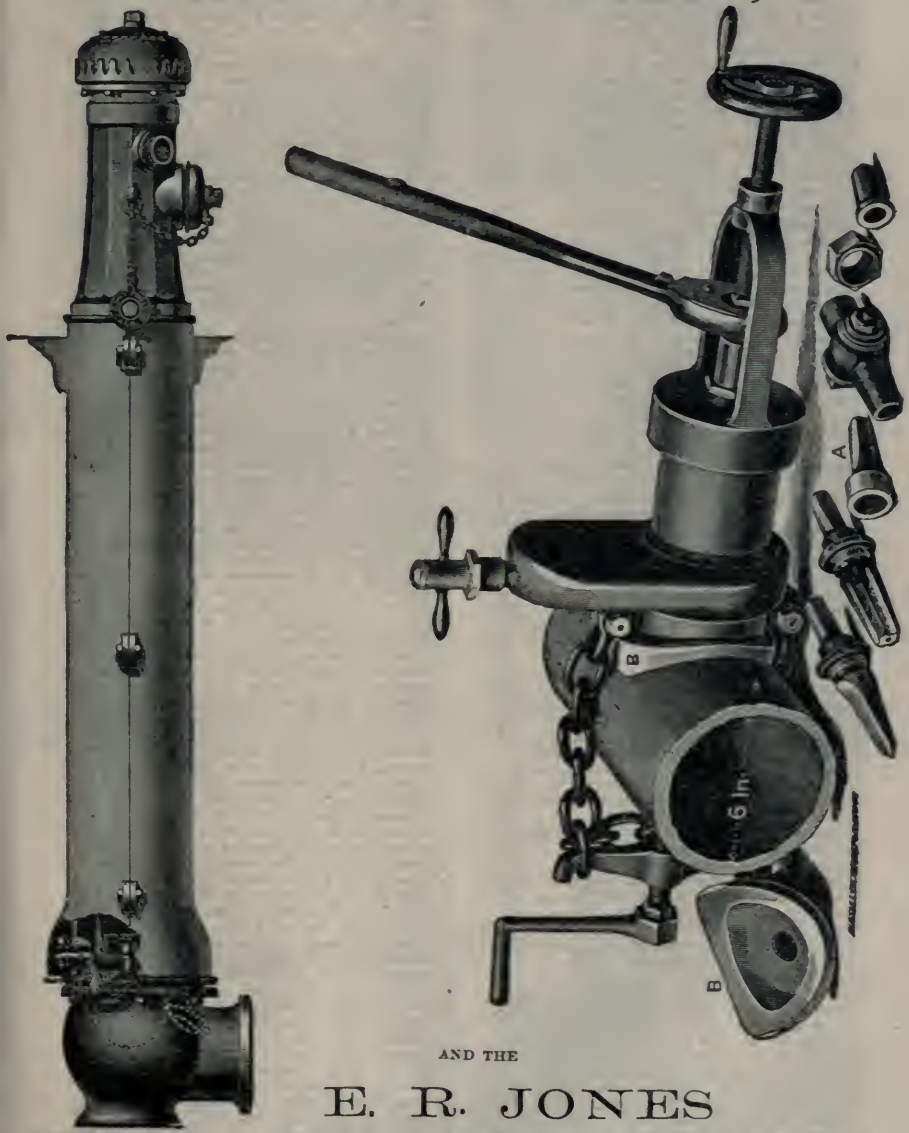
Superintendents.

Keller, H'y A., Suspension B, N. Y.. 183
Kelley, Wm. P., Scranton, Pa..... 252
Kellogg, F. W., Newark, N. Y..... 162
Kellogg, R. C., Elizabethtown, N. Y. 141
Kenley, Wm. L., Baltimore, Md..... 292
Kennedy, A. H., Rockport, Ind..... 398
Kennedy, J. S., Nebraska City, Neb.. 533
Kenniston, A., Booth Bay Harbor, Me 4
Kent, W., Narragansett Pier, Conn.. 104
Kent, W. A., Jamestown, N. Y..... 154
Kenworthy, W. J., St. Ignace, Mich.. 427
Kern, J., Marquette, Mich..... 420
Kerr, H. E., Wahoo, Neb..... 537
Kiefer, L., Piqua, O..... 379
Kieran, P., Fall River, Mass..... 53
Kilbourne, E, Newington, Conn..... 116
Kimball, J., Mitchell, So. Dakota..... 541
Kimball, N. W., Dubuque, Ia..... 482
Kimble, E. M., Buena, Vista, Colo... 588
King, E. W., Gt. Falls, Mont 553
King, Jno. D., New Brighton, Pa..... 254
King, Jno. H., Belvidere, N. J..... 196
King, Saml. L., Bristol, Tenn..... 344
Kingsley, Stephen L, Bar Harbor, Me 3
Kinney, E. C., Green River, Wyo.... 550
Kirkpatrick, M., Marinette, Wis...., 469
Kittredge, W. C., Tunkhannock, Pa.. 279
Klinedensi, Alex., Westminster, Md.. 296
Klyersteuber, F., Crystal Falls, Mich. 408
Knapp, Louis H., Buffalo, N. Y..... 133
Kniffin, A. T., Cohoes, N. Y..... 138
Knouse, B. F., Corry, Pa 229
Knowles, Wm., Newport, Ark... 569
Knox, Jas. B., Clarion, Pa..... 227
Koch, E., Alexander, Ark..... 566
Koch, H. G., Aspen, Colo..... 587
Kocher, T., Selin's Grove, Pa 272
Koenig, F., Healdsburg, Cal..... 620
Koons, C. W., Mt. Vernon, O..... 377
Kornitz, R. F., Neillsville, Wis..... 471
Kramer, Jno., Holland, Mich..... 416
Kress, W. C., Wellsborough, Pa..... 283
Kreuse, F. E., West Point, Neb..... 538
Krieger, A. H., Salamanca, N. Y..... 179
Krueger, H., Kendallville, Ind..... 393
Krusen, W. J., Grand Junction, Col.. 593
Kuehn, Jacob L., York, Pa. 285
Kuhn, Wm., Mt Joy, Pa..... 253
Kuhn, W. S., Pittsburgh, Pa., 229, 395, 474
La Barr, S. E., Webster City, Ia..... 493
Lacey, James, Ellendale, No. Dak.... 546
Lafleur, W. H., Escanaba, Mich..... 410
Laforest, Pierre, Joliette, P. Q. 658
Laine, O. O., Canisteo, N. Y..... 135
Laing, W. H., Racine, Wis..... 473
Lakin, Jno. T., Rockford, Ill..... 455
Lamb, J. A., Independence, Cal.. . 621
Lamb, J. Warren, Cooperstown, N. Y., 139, 171
Lambert, I. B., Pasadena, Cal..... 627
Lamon, Judson A., Seymour, Ind..... 399
Lamoreux, W. O., Stevens' Point, Wis..... 474
Lance, O. M., Plymouth, Pa..... 266
Landis, B. F., Shippensburgh, Pa..... 274
Lane, C. J., Bradford, Pa..... 224
Langdon, W. F., Plymouth, N. H..... 24
Larmon, John, Cambridge, N. Y..... 134
Lautz, Henry, Pekin, Ill..... 452
Lawton, E., Ironton, O..... 372
Lawton, E. A., Akron, O 360
Lay, H., Elko, Nev 644
Leatherberry, J. M., Middletown, Del 287
Leatherwood, R. N., Tucson, Ariz.... 613
Leclaire, J. J. H., St. Jerome, Ont.... 674
Ledlie, J. H., Brenham, Tex 572
Le Fever, John Z., Olean, N. Y 170
Lehman, B. E., So. Bethlehem, Pa.... 275
Leonard, Francis, Norwalk, Conn ... 117
Lewis, Chas. T., Hannibal, Mo 556
Lewis, P. J., Schenevus, N. Y 180
Lillie, S. J., Fort Buford, No. Dak.... 547
Linton, W. H., Ravenna, O 380
Livermore, N. G., Millville, N. J..... 206
Lockwood, C. A., Far Rockaway, N. Y. 143
Lockwood, Jno. C., Jamaica, N. Y.... 154
Lockwood, Jos. A., Yonkers, N. Y.... 194
Loder, Orrin J., Peekskill, N. Y..... 172
Long, Jr., Jas., Rapid City, So. Dak.. 543
Long, J. T., Staunton, Va..... 309
Loomis, D. H., Unadilla, N. Y..... 186
Lord, A. B., Ogdensburgh, N. Y..... 169
Lord, E. M., Mt. Vernon, Ind..... 395
Lott, Jeremiah, Flatbush, N. Y..... 143
Lovell, Thos. C., Fitchburg, Mass.... 54
Low, Philo, Saugerties, N. Y..... 180
Lowe, H. H., Clinton, Mass 49
Ludlow, F. K., Arch Beach, Cal..... 615
Ludwick, D. B., New Philad'a, O..... 378
Lyman, I. L., Lincoln, Neb 532
Lynch, Frank, Tamaqua, Pa..... 277
Lyons, Mr., Canton, Mass..... 48
McAllister, A. F., Marshall, Tex..... 580
McAllister, Willis E., Calais, Me..... 5
McAllister, W. E., St. Stephens, N. B..... 651
McAuley, A. L., Morrisonville, Ill.... 450
McCanne, D. J., Gunnison, Col..... 594
McClintock, G. L., Tazewell, Va..... 310
McClure, A. H., W. Liberty, Ia.. ... 494
McConnell, B. D., Montreal, P. Q..... 660
McConnell, Frank, Cretę, Neb..... 529
McConnell, Ira, Crawfordsville, Ind. 389
McConnell, J. H., Minneapolis, Minn. 499
McCranne, D. J., Crested Butte, Col. 590
McCrea, Frank A., Catonsville, Md.. 292
McCue, W., Ottumwa, Ia..... 491
McCulloch, R. E., Clarksville, Tenn.. 345
MacCullum, A. W., 400 Chestnut St., Philadelphia, Pa.....227, 229, 337, 400
McCusker, Jno. E., Gloucester, Mass. 55
McCusker, J. E., Newburyport, Mass..... 72
MacDonald, A., Athol, Mass..... 37
McDowell, A. W., Cloquet, Minn..... 496
McDowell, Felix, N. Tarentum, Pa... 277
McFarland, C. A., Hollidaysburgh, Pa..... 239
McGarry, Roger, Wilkesbarre, Pa... 284
McGrath, A. C., Chambersburgh, Pa. 227
McGrovy, Michael, Lakewood, N. J 205
McHenry, Robt., Modesto, Cal..... 623
McIlvanie, E. S., Lawrenceville, N. J. 205
McIntosh, Alex., Huron, So. Dak..... 541
McIntyre, A. W., Clare, Mich..... 408
McKay, Alex., Decorah, Ia..... 481
McKenzie, T. H., Southington, Conn.. 120
McKinnon, W., Athens, Ga..... 322
McLain, V., Greenville, Ill..... 444
McLeary, Jno., Walston, Pa..... 281
McMartin, J. A., Ft. Gratiot, Mich.... 411
McNulty, C., Columbus, Kan..... 509
McWilliams, Jas. A., Seattle, Wash... 606
Madden, D. W., Tulare, Cal..... 638
Maess, Frank, Seattle, Wash..... 606
Magnon, A., Laredo, Tex..... 579
Main, Thos., Marblehead, Mass..... 67
Manchester, G. L. Easthampton, Mass..... 52
Maneval, S. H., E. Palestine, O..... 369
Mann, Ezra B., Woodsville, N. H..... 26
Mann, Jas., Dowagiac, Mich..... 409
Manning, C. F., Hagerstown, Md..... 295
Marsh, Jno. J., No. Adams, Mass.... 73
Marshall, G. M., Kilbourn City, Wis. 467
Martin, A. C., Seneca Falls, N. Y..... 181
Martin, A. E., So. Framingham, Mass. 82
Martin, Benj. B., Bristol, R. I..... 97
Martin, C. C., Weeping Water, Neb... 537
Martin, C. F., Bellefontaine, O 361
Martin, C. H., Sioux Falls, So. Dak.... 544
Martin, Henry P., Owensboro', Ky... 357
Martin, J. M., Salem, Ore..... 613
Martin, F. M., Palouse, Wash 605
Martine, A. H., Knoxville, Tenn 346
Maslin, J. W., Havre de Grace, Md. 295
Mason, C. B., Danbury, Conn 110
Mason, L. C., Independence, Kan.... 515
Mason, Marshall, St. Albans, Vt 31
Maur, Jos., Sorel, P. Q..... 663
Maxwell, E. N., Texarkana, Ark . 570
May, Emmanuel, Valleyfield, P. Q.. 663
Mather, M. W., Glenwood Spg's, Col. 593
Mellon, W. H., Schuylkill Haven, Pa. 271
Mercer, E. P., West Chester, Pa...243, 284
Meredith, Reuben, Millville, N. J ... 206
Meredith, W. B., Kittanning, Pa., 225, 243, 281
Merrill, F. B., Canandaigua, N. Y... 135
Merrill, Parker, Melrose, Mass..... 68
Merritt, Ezra, Ashburnham, Mass.. 37
Merritt, Geo., Sag Harbor, N. Y..... 178
Messenger, C. C., Howard City, Mich 417
Meyer, Geo. S., Waynesborough, Pa. 283
Middlemist, J., Dehli, N. Y..... 140
Miller, A. C., Faribault, Minn..... 497

CARR'S PATENT HYDRANTS

WITH OR WITHOUT

Supplementary or Double Valves,



AND THE

E. R. JONES

TAPPING MACHINES,

For Inserting service stops from ⅛ to 1¼ inch. Used in all the larger cities.

MANUFACTURED ONLY BY **CHARLES CARR,** CONSULTING MECHANICAL ENGINEER.

Office, 7 Exchange Place, Boston, Mass.

Formerly Vice-President and Manager of Boston Machine Co. and Boston Machine Mfg. Co.

MACHINERY OF ALL KINDS and WATER-WORKS SUPPLIES DESIGNED AND DETAILED DRAWINGS FURNISHED.

Construction Superintended and Contracted for. Attention given to office and outside work.

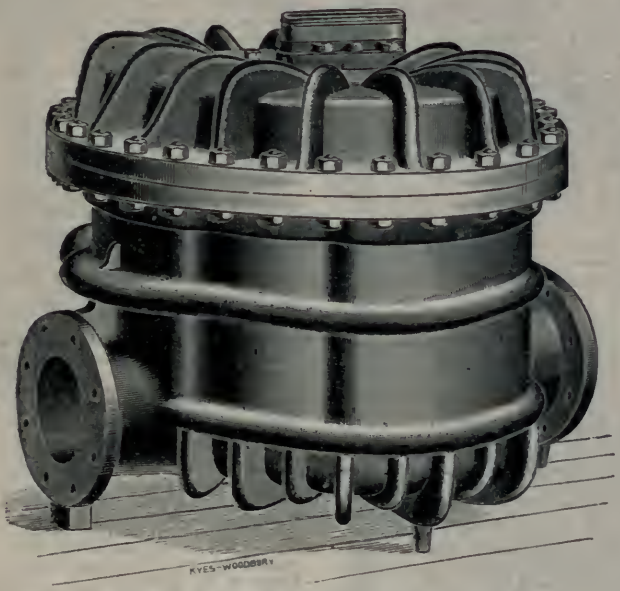
Superintendents.

Miller, Alvin N., Savannah, Ga.... 326
Miller, B. J., Holden, Mo.... 556
Miller, Donnell, Cheyenne, Wyo 549
Miller, E. B., Coquille, Ore 610
Miller, F. M., Asheville, N. C.... 315
Miller, J., Plymouth, Ind 397
Miller, Samuel A., Centralia, Pa 226
Miller, Wm. C., Newburgh, N. Y.... 163
Miller, W. I., Red Wing, Minn 500
Millpaugh, J. L., San Angelo, Tex.... 581
Mills, D. J., Menlo Park, Cal.... 623
Mills, J. Albert, St Catharines, Ont.. 674
Mills, M. H., Mt. Morris, N. Y.... 161
Mines, W. W., Camden, N. J.... 200
Mintzer, S. C., Attica, Ind.... 388
Mitchell, Richard, Guelph, Ont.... 667
Moffet, W. R., Honesdale, Pa.... 240
Moffett, J. E., Clinton, Ill.... 439
Molis, W., Muscatine, Ia.... 489
Moncreuth, A., Geneseo, Ill.... 444
Monie, Wm., Moosic, Pa.... 253
Monroe, Harvey G., Pontiac, Mich.... 425
Montague, H. O., Silverton, Colo.... 599
Montegel, Jr., J. M., Alma, Mich.... 403
Moore, Arthur G., Cincinnati, O., 361, 364, 366
Moore, C. S., Martin's Ferry, O.... 375
Moore, Gustavus, Gardiner, Me.... 8
Moore, O., Fergus Falls, Minn.... 497
Moorehouse, D. W., Ovid, Mich.... 424
Moriarty, D. D., Emlenton, Pa.... 233
Morley, P., E. Liverpool, O.... 369
Morrow, C. C., Chamberlain, So. Dak. 540
Morse, C. W., Haverhill, Mass.... 56
Morse, J. W., Natick, Mass.... 70
Morse, W. B , St. Clair, Mich 427
Morse, W. J., Wallingford, Conn.... 123
Morton, B. R., Newport, Ky.... 357
Moses, G. N. & E. R., Great Bend, Kan.... 514
Mosley, C. W., Nanticoke, Pa. 253
Moulton, H. S., Willimantic, Conn.... 125
Mulholland, Wm., Los Angeles, Cal.. 622
Mullen, Ed., Renovo, Pa.... 268
Munro, D., Woodstock, N. B.... 652, 680
Munson, Geo., Connellsville, Pa.... 229
Murdoch, Gilbert, St. John, N. B.... 651
Murrin, Jno. A., Rock Island, Ill.... 455
Nash, H., Georgetown, Col.... 593
Nash, Jno. F., Waterville, Me.... 14
Nason, Wm. E., Franklin, Mass.... 54
Neale, B. A., Mayfield, Ky.... 356
Neave, J. B., Salisbury, N. C.... 317
Nelson, Nath., Wellsburgh, W. Va... 313
Nelson, S. L., Champaign, Ill.... 436
Nesbit, J. J., Larned, Kan.... 516
Nettleton, Chas. H., Birmingham, Conn.... 107
Nettleton, E. M., Clifton Forge, Va.. 300
Nevons, Hiram, Cambridgeport, Mass. 47
Newman, E., Porterville, Cal.... 629
Newton, Wm., Prairie du Chien, Wis. 472
Nichols, E. M., Madison, Wis.... 468
Nichols, H. J., Pomona, Cal.... 628
Nippert, M., Ligonier, Ind.... 394
Noble, John T., St. Louis, Mich.... 428
Noble, T. J., Ellsworth, Kan.... 511
Nock, Jno. A., San Luis Obispo, Cal.. 635
Norcross, F. C., Lorain, O 374
Norris, Ed., Hampton, Va.... 302
Norris, James H., Ballston Spa, N. Y. 131
Norris, Prof. J. L., Ithaca, N. Y.... 139
Norris, John W., Gilroy, Cal.... 620
Northup, H. A., Cheshire, Mass.... 48
Norton, M. M., So. Norwalk, Conn.... 121
Norton, T. A., Oneonta, N. Y.... 170
Norton, W. D., Phelps, N. Y.... 173
Nulton, John H., Winchester, Va 310
Nyce, Geo. W., Fairplay, Col.... 592
Oakley, E. C., Bethel, Conn 106
Oates, G. W., White Cloud, Mich.... 430
O'Brien, Patrick, Girardville, N. Y.... 237
Ocobock, H. N., Wyandotte, Mich.... 430
O'Connor, M., Bayonne, N. J.... 196
Odell, L. J., Columbia, Tenn.... 346
Ohliger, L. B., Canton, O.... 362
Olcott, Geo. P., E. Orange, N. J.... 201
Oliver, T. J., E. Dallas, Tex.... 576
O'Lone, Wm., Erie, Pa.... 234
Opp, Geo. B , Meridian, Miss.... 341
Ormiston, Dan'l, New Glasgow, N. S. 654
Osborne, D. B., Girard, Kan.... 513
Ottmann, Louis, Mamaroneck, N. Y.. 160
Ottinger, G. M., Salt Lake City, Utah. 647
Overton, J. B., Virginia City, Nev .. 646
Overton, John B., St. Paul, Minn.... 502
Owens, James, Montclair, N. J. 207
Page, C. S., Hyde Park, Vt.... 29
Page, I. P., Lynchburg, Va.... 305
Parish, H. G., Morrison, Ill.... 450
Parker, J. E., La Crosse, Wis.... 468
Parker, T. R., Napa City, Cal.... 624
Parkin, R. R., Elgin, Ill.... 441
Parr, E. R., Marshall, Mo.... 560
Parrot, E. D., Arlington, Ore.... 609
Parsons, J. F., Emporium, Pa.. 233
Parry, Howard, Riverton, N. J.... 213
Pate, R. R., Orleans, Neb.... 535
Patton, John, Jr., Sewickley, Pa.... 272
Paul, E. S., El Paso, Ill.... 442
Paul, Mifflin, Seabright, N. J.... 214
Paulison, Washington, Passaic, N. J. 211
Payne, Fred J., Argentine, Kan.. 505
Payne, I. W., Adams, N. Y.... 126
Payne, L. C., Lisbon, N. H.... 21
Peck, E. H., Coolidge, Kans 509
Penniman, C. D., Windsor, Vt.... 34
Perkins, John H., Watertown, Mass. 89
Peters, Hugh B., Goldsborough, N.C. 316
Pettis, E. G., Union City, Ind.:.... 400
Pettit, R., San Marcos, Tex.... 582
Pettypiece, Geo., Wingham, Ont.... 680
Phelps, J. W., Fishkill, N. Y.... 102
Phelps, Nelson D., Barre, Vt.... 27
Philbin, J. F., Clinton, Mass.... 60
Phillips, Fredk., Stroudsburg, Pa... 276
Phillips, W. H., W. Bay City, Mich. 430
Phinney, Frank F., Stoughton, Mass. 85
Phipps, E. H., W. Haven, Conn.... 124
Phirman, J. H., The Dalles, Ore.... 613
Pickett, Chas., Beverly, Mass.... 39
Pierce, F. H., Las Vegas, N. M. 601
Pierce Wm. L., Gainesville, Tex.,.... 577
Pierson, W. C., Catskill, N. Y. 136
Pingree, Job., Ogden, Utah.... 647
Pitman, Lycurgus, N. Conway, N. H. 23
Pollard, Kendall, Swampscott, Mass. 86
Pope, Geo. A., Belleville, Ont.... 664
Porter, W. H., Gordonsville, Va.... 302
Porter, W. W., Woodland, Cal.... 641
Porteus, W., Cairo, Ill.... 434
Potter, T. Z., Housatonic, Mass.... 59
Potter, Z., Wooster, O.... 386
Power, Francis, Alexandria, Va.... 300
Pratt, W., Utica, N. Y.... 187
Prescott, A. M., Waco, Tex. 585
Priddy, C. W., Leadville, Colo.... 596
Prince, G. C., Oberlin, O.... 378
Privett, D. J., Jacksonville, Fla.... 336
Pudoch, J. G., Sand Beach, Mich.... 428
Pulman, S. W., Fonda, N. Y.... 143
Purcell, Chas., Oakland, Cal 625
Pushard, Jno. L., Richmond, Me.... 12
Putnam, C. M., Deposit, N. Y.... .. 141
Putman, E. H., Bennington, Vt. 28
Quimby, Geo. H., Warren, O.... .. 384
Quinn, Ed. Gale, Pensacola, Fla.... 330
Quinn, J. S., Fredericksburg, Va 302
Quint, N. M., Peabody, Mass. 75
Race, A. S., Fredonia, Kan.... 513
Rader, J. P., Easton, Pa.... 232
Ramsey, Chas. E., Carlisle, Pa 226
Ramsey, Jno. W., Beaver Falls, Pa.. 220
Ramsey, W. R., Brookville, Pa.... 225
Rand, A., Oakdale, Cal.... 625
Rand & Rice, Claremont, N. H.... 16
Randall, John, Mio, Mich.... 421
Rankin, W. A., New Lisbon, O.... 378
Ranney, Geo., St. Johnsbury, Vt.... 32
Ratz, Chas. E., Punxsutawney, Pa... 267
Reade, J. W., Baraboo, Wis.... 461
Reade, Jas. W., Portage, Wis.... 472
Reaves, Robt., Scranton, Pa 272
Redington, R. J., Troy, Pa.... 279
Redmon, G. S., Pipe Stone, Minn.. .. 500
Reed, J. C., Alliance, O.... .. 360
Reed, Thos. J., Orwigsburgh, Pa.... 257
Reed, Wm. S., Kankakee, Ill.... 446
Reiff, C. F., Fremont, O.... 371
Reinhold, F. H., Montrose, Col.... 597
Reiner, A., Blue Island, Ill.... 433
Renkawitz, J., Michigan City, Ind.... 395
Reyer, Geo., Nashville, Tenn. 350
Reynolds, Fred C., Moravia, N. Y.... 160
Reynolds, Johnson, Los Angeles, Cal. 622
Reynolds, Wm. O., Baker City, Ore... 610

UNION WATER METER CO.,

WORCESTER, MASS.

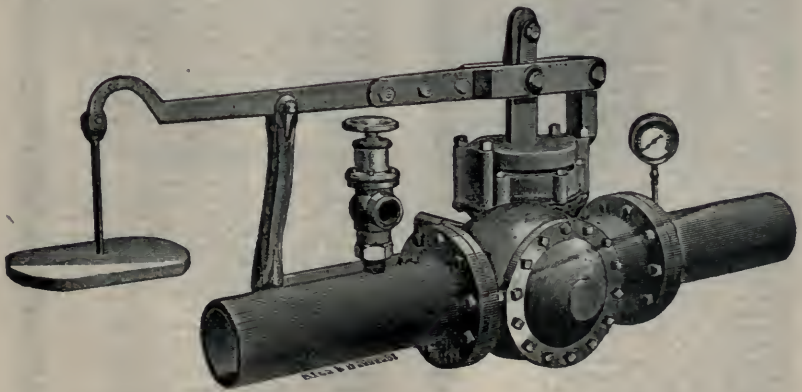
SEND FOR CATALOGUE.



OVER 30,000 IN USE.

6 IN. EXTRA HEAVY ROTARY WATER METER.

Water Meters and Water Pressure Regulators.

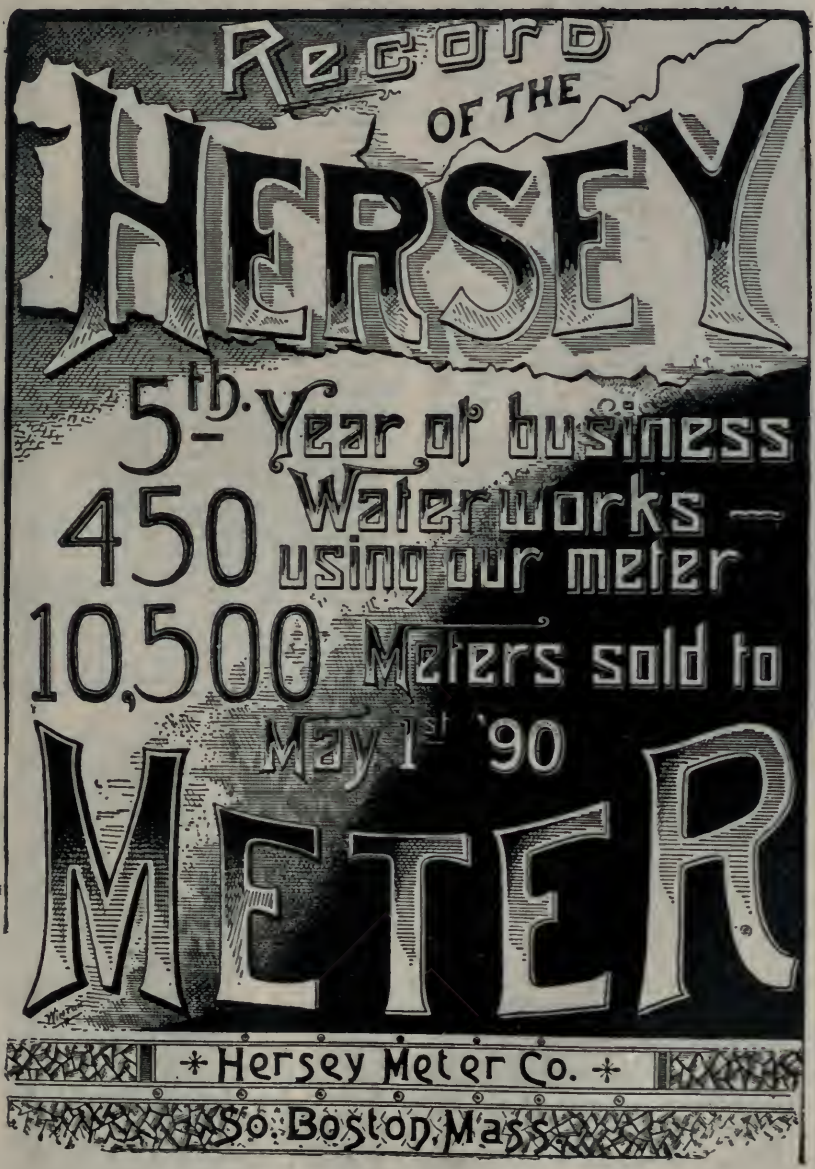


AUTOMATIC WATER PRESSURE REGULATOR.

METERS SENT TO WATER-WORKS FOR TRIAL.

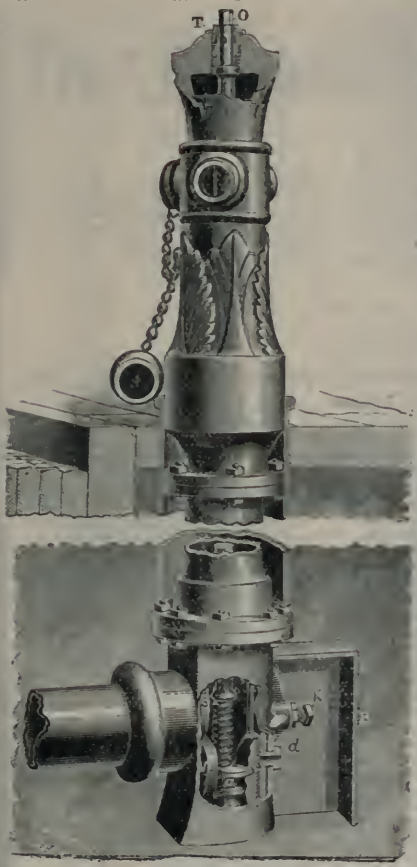
Superintendents.

Rhodes, D. H., Kingman, Kan.. 514
Rice, E. C., Mandan, No. Dak..... 548
Richards, W. G., Atlanta, Ga..... 322
Richards, W. H., New London, Conn. 116
Richardson, A. B., Athens, O..... 360
Richardson, Geo., Bridgeport, Conn.. 109
Richardson, G. W., Charlotte, Mich.. 407
Richardson, J. H., Niles, Mich..... 423
Richardson, J. S., Tilbury Center, Ont..... 676
Richardson, L. J., Homer, N. Y..... 151
Richmond, G. S., Petoskey, Mich..... 425
Richmond, Lemuel, W. Randolph, Vt. 33
Richtmeyer, B. F., Jackson, Cal..... 621
Rickert, Sam'l, Summit Hill, Pa..... 276
Ricks, H. L., Eureka, Cal..... 619
Riddle, Jas. H., Wheeling, W. Va.... 314
Riddle, Taylor, Marion, Kans..... 518
Ries, Geo. J., Weymouth, Mass..... 92
Riley, W. H., Taylor, Tex..... 583
Rily, W. L., Hailey, Ida..... 648
Ringle, P., Wausau, Wis..... 475
Risdon, H. C., Mt. Holly, N. J..... 208
Roberts, J. M., Bainbridge, N. Y..... 130
Roberts, L. C., Anacortes, Wash..... 603
Robertson, D. H., Springfield, Mo.... 565
Robertson, Geo. H., Yarmouth, N. S.. 655
Robertson, Geo. Y., Owego, N. Y..... 171
Robinson, Alex., Benicia, Cal..... 616
Robinson, E. J., Sharon, Pa..... 273
Robinson, E. W., Paola, Kans..... 521
Robinson, S. F., Clyde, Kans 508
Robinson, W. B., Scotland, So. Dak.. 543
Rockwell, S. L., Jordan, N. Y..... 155
Roden, Thos., Arlington, Mass..... 37
Rogers, Henry W., Salem, Mass..... 80
Rogers, J. J., Edgar, Neb..... 529
Rogers, Jno. D., Round Lake, N. Y.... 178
Rongon, Jno. Winnemucca, Nev..... 646
Roof, F. O. Walsenburg, Col..... 600
Root, H. D., Lyons, Ia..... 486
Rosenow, C. B., Fort Collins, Col..... 592
Rosse, S. F., Sedalia, Mo 564
Roosevelt, C. E., Pendleton, Ore..... 612
Roullier, G. A., Flushing, N. Y..... 143
Rowland, Geo. H., Columbus, O..... 379
Rowley, H. W., Billings, Mont..... 551
Roy, John S., Hudson, N. Y..... 152
Royer, Hiram, Pottstown, Pa..... 266
Rubel, Jno., Lebanon, Ky..... 354
Rudisell, H. E., Anniston, Ala..... 333
Rudisill, H. B, Anniston, Ala..... 332
Russell, F., Chebanse, Ill..... 436
Russell, W. S., Grand Forks, No. Dak. 547
Ryan, Saml. D., Bellefonte, Pa..... 221
Ryle, Wm., Paterson, N. J..... 211
Rynear, L., Ocean Grove, N. J..... 210
Sabin, Geo., Malone, N. Y..... 159
St. John, J. W., Walton, N. Y..... 187
Salisbury, A., Watertown, N. Y..... 189
Salisbury, A. H., Lawrence, Mass..... 61
Salsbury, N., Wisner, Neb..... ... 538
Sanders, D. H., Marion, Ind..... 395
Sanderson, R. H., Marshall, Mich.... 421
Sanford, Chas. G., Williamstown, Mass..... 93
Sanford, Wm. C., Stockton, Kan. 525
Sangster, Andrew, Sherbrooke, P. Q.. 663
Sabell, W. M., Golden, Col..... 593
Saunders, W. F., Penn Yan, N. Y.... 173
Saup, R. M., Zanesville, O 387
Sawyer, Wm. H., Pen Argyl, Pa..... 258
Sayler, Don A., Valparaiso, Ind..... 400
Scannell, M., Tiffin, O 383
Schaeffer, A., Maysville, Ky..... 356
Schafbuck, Jno., Marengo, Ia..... 487
Schaffer, J. M., Martinsburgh, W. Va..... 312
Schmidt, H. W., Bloomington, Ill ... 433
Schneider, A., Anaheim, Cal..... 615
Schofield, A., Frostburgh, Md..... 294
Schram, M. S., St, Johnsville, N. Y... 179
Schrof, Ira S., So. Bend, Ind 399
Schussler, Chas., Folsom, Cal..... 641
Scoble, A. W., Ft. Worth, Tex..... 576
Scott, E. W., Oceanside, Cal..... 626
Scott, T., Mount Carmel, Pa 253
Scribner, W. H., Bakersfield, Cal..... 616
Scriver, E. A., Merrill, Wis..... 469
Seager, G. E., Randolph, N. Y..... 176
Sealy, W. F. P., Pottsdam, N. Y..... 175
Seaton, B. F. Marion, Ia..... 487
Seaton, G. H., Uniontown, Pa..... 280
Sedgeley, J. L, Cloverdale, Cal..... 617
Seevir, Chas., Corsicana, Tex..... 574
Seifert, A., Mechanicsburgh, Pa 249
Sekell, A C., Lowell, Mich..... 419
Sells, Wm., Neola, Ia..... 489
Serviss, Gordon, Iroquois, Ont..... 668
Sevier, S. Q., Camden, Ark..... 567
Seward, E. B., Santa Fé, N. M..... 602
Seymour, C. W. S., Hingham, Mass.. 57
Seymour, H. G., Chillicothe, Mo..... 555
Shamp, H. B., Chippewa Falls, Wis.. 463
Shannahan, Wm. E., Easton, Md..... 294
Sharpe, C. D., Putnam, Conn..... 119
Sheaff, E. H., Mt. Vernon, N. Y..... 161
Shenston, T. M., Brantford, Ont..... 665
Shepard, E., Seattle, Wash..... 606
Shields, C., Truckee, Cal..... 638
Shields, G. A., So. Pueblo, Col..... 599
Shirk, R. J., Lebanon, Pa..... 245
Show, D. A., Azusa, Cal..... 616
Sidner, Wm., Hackettstown, N. J. ... 202
Sigel, Geo., Carlinville, Ill..... 435
Sill. A. N., Hot Springs, Ark 568
Silliman, Jr., E., Mahanoy City, Pa... 248
Simpson, B. V., Winona, Minn..... 503
Simpson, I. H., Brunswick, Me..... 5
Singley, L. N., Waynesburgh, Pa..... 283
Skinner, I. A., Pacific Grove, Cal..... 627
Slater, E. A., Rich Hill, Mo..... 561
Slingluff, Jno., Norristown, Pa. 255
Slocum, Wm. S., Newport, R. I..... 98
Smith, Blair, Wenonah, N. J..... 216
Smith, Brooke, Brownwood, Tex..... 572
Smith, C. H., Bellevue, O..... 362
Smith, Frank, Wayne, Pa..... 282
Smith, F. P., Columbus, Ind 389
Smith, G. Parker, Windsor, N. S..... 655
Smith, H. L., Brookfield, Mass..... 43
Smith, I. W., Portland, Ore..... 613
Smith, J. Harper, Raritan, N. J..... 215
Smith, John E., Andover, Mass..... 36
Smith, L. D., Sandwich, Ill..... 456
Smith, M., Watertown, So. Dak..... 544
Smith, N. K., Belton, Tex..... 572
Smith, Solon F., Grafton, Mass..... 55
Smith, W. R., Springfield, O. 382
Snow, Geo. M., Ketchum, Ida..... 649
Snow, W. W., Hillburn, N. Y..... 151
Southard, Henry, Phillipsburgh, Pa. 264
Souther, Sam'l A., Patchogue, N. Y. 172
Sparks, Frank E., Bangor, Me.. . . . 3
Sparks, H. T., Brewer, Me..... 5, 15
Spaulding, Z. S., Ft. Payne, Ala..... 335
Spencer, C. Y., Dalton, Ga..... 325
Spooner, E. E., Rochelle, Ill..... 454
Sprong, C. H., Houston, Tex..... 578
Stacey, F. S., Chillicothe, O..... 363
Stacey, Geo. A., Marlborough, Mass. 67
Stalter, Jas., Redwood City, Cal..... 631
Starkweather, C., St. Paul, Neb..... 536
Stearns, R. G., Kinsley, Kan..... 516
Steele, Jno. J., Mexico, Mo..... 561
Steele, Jno. M., Bordentown, N. J.. 197
Steele, Jno M., Peterborough, N. H. 23
Stephens, B. F., Painesville, O..... 379
Sterley, M. S., Reynoldsville, Pa.. .. 268
Stern, A., Logan, Ia..... 486
Sternborg, J. M., Plainwell, Mich.... 425
Sterns, J. C., Charles City, Ia 479
Sterrett, R. J., Lockport, N. Y..... 158
Stetser, Henry, Beverly, N. J..... .. 196
Stetson, C. J., Albuquerque, N. M.... 601
Stevens, E. E., Larned, Kan..... 506
Stevens, S. M., Defiance, O..... 368
Steward, Jno., Peru, Ind..... 397
Stewart, Jno., So. Easton, Pa 275
Stewart, J. S. Tilbury Centre, Ont.... 676
Stewart, J. S. Tilbury Centre, Ont.... 48
Stickney, E. R., Chicopee, Mass..... 220
Stier, Chas. K., Bangor, Pa 681
Stirtan, J. W., Esquimault, B. C..... 401
Stitt, N. S., Wabash, Ind..... 433
Stooky, M. T., Belleville, Ill..... 394
Storey, G. H., La Porte, Ind..... 59
Stratton, D. W., Hudson, Mass..... 440
Straw, L. W., Danville, Ill 500
Streator, C. W., Rochester, Minn..... 134
Streator, Wm., Camden, N. Y..... 369
Street, Chas. B., Dennison, O..... 666
Strickland, Jas., Cornwall, Ont..... 416
Striggon, L. J., Holly, Mich 219
Stringfellow, S. T., Apollo, Pa..... 301
Stroffregan, R. E., Fredericksburg, Va. 391
Stubbs, J. W., Greencastle, Ind..... 391


Record of the
HERSEY
5th Year of business
450 Water works —
using our meter
10,500 Meters sold to
May 1st '90
METER
Hersey Meter Co.
So. Boston, Mass.

Superintendents.

Stueben, B. F., Brockville, Ont ... 665
Sturtevant, G. W , Minneapolis, Minn. 528
Stryker, Geo. G., Phillipsburgh, N. J. 212
Sullivan, Eugene, So. Boston, Mass... 41
Sullivan, J. F., S oux City, Ia..... 493
Surtees, Robt., Ottawa, Ont..... ... 672
Sutton, Wm. T., Chestertown, Md... 293
Swain, A. C., Merced, Cal..... 623
Sweet, Van R., Phœnix, N. Y..... 173
Taft, C. A., Uxbridge, Mass..... 87
Taggle, M. H., Columbus, Ga..... . 325
Tarleton, A., Columbia, Cal..... 618
Taylor, A., Smyrna, Del..... 288
Taylor, B. F., Cortland, N. Y..... 140
Taylor, C. H., Kokomo, Ind..... 393
Taylor, I. M., Garden City, Kan..... 513
Taylor, Isaac S., Holmesburgh, Pa... 240
Taylor, J., Carlyle, Ill. 435
Taylor, J. W., New Castle, Pa..... 255
Taylor, Wm., College Point, N. Y..... 138
Taylor, Wm. D., Dover, N. H..... 18
Tefft, O. A., Sandy Hill, N. Y..... 179
Tennant, Jas., Hart, Mich..... 415
Tenney, J. G., Leominster, Mass..... 62
Thayer, F. D., Honesdale, Pa..... 241
Thayer, Geo. A., Carson City, Mich.. 407
Thomas, C. O., Caro, Mich..... 407
Thomas, E. A., Ft. Smith, Ark..... . 567
Thomas, Geo. H., Glens Falls, N. Y.. 146
Thomas, Geo. S., New Bethlehem, Pa 254
Thomas, P. S., Harrisonburg, Va..... 302
Thomas, R. L., Ebensburgh, Pa..... 232
Thomas, W. H., Swanton, Vt..... 32
Thomas, W. J., Georgetown. Tex.... 577
Thomas, W. R., Catasauqua, Pa..... 226
Thompson, E. O., Thomasville, Ga... 327
Thompson, Sam'l S., Allentown, Pa.. 218
Thorndyke, H. H., Bridgewater, Mass 42
Thorpe, Edw. S., Merchantville, N. J. 206
Thralls, J. M., Wellington, Kas..... 526
Thresher, M. S., Stockton, Cal..... 637
Tichenor, D., Dallas, Tex..... 575
Tight, Chas , Granville, O..... 371
Tillinghast, S. W., Fayetteville, N. C. 316
Tod, Jr., Gen., Centinela, Cal..... 617
Tod, Jr , Geo., Redondo Beach, Cal.. 630
Todd, W. V., Tuscaloosa, Ala..... 339
Tourtelotte, M. L., West Springfield, Mass..... 92
Tower, D. N., Cohasset, Mass..... 50
Traenmer, Geo. P., Milwaukee, Wis. 470
Trask, F. E., Ontario, Cal..... 626
Treman, E. M., Ithaca, N. Y..... 154
Trotter, J. G., Marshalltown, Ia..... 487
Troy, J. W., Pierre, So. Dak..... 543
Trump, E. D., Jersey Shore, Pa... 241, 242
Tubbs, Geo. L., Hornellsville, N. Y.. 152
Tubbs, J. Nelson, Rochester, N. Y.... 177
Turner, C. L., El Dorado, Kan..... 510
Turner, F., Nevada, Ia..... 489
Turner, Jas., Downs, Kan..... 510
Turner, Jno. H., Mobile, Ala..... 337
Turner, Robt., Sarnia, Ont..... 675
Turner, S. K., Carrollton, Mo 554
Tuts, Wm., Carbondale, Pa..... 225
Tuttle, Chas., Kingman, Kan..... ... 516
Ulrich, J., San Antonio, Tex..... 582
Ulzes, C., New Braunfels, Tex..... 581
Utter, G. H., Silver City, N. M..... 602
Van, Jno. A., Pleasant Hill, Ky..... 358
Vanatta, A. J., Waverly, N. Y ... 190
Vanatta, J. K., Colorado City, Colo. . 589
Van Buskirk, E. M., Clyde, N. Y .. 137
Vandeboget, R. A., Palmyra, N. Y.... 172
Vanderslice, A. S., Phœnixville, Pa.. 264
Van Duzer, C. A., Gouverneur, N. Y.. 147
Van Duzer, I. F., Middletown, N. Y.. 160
Van Studdeford, — Havana, Ill..... 444
Vaughan, Isaac C., Hyde Park, Vt... 29
Vaughn, W. H., Wellesley Hills, Mass..... 90
Veach, Wm. A., Newark, O..... 377
Veenum, J. F., Jamestown, N. Dak.. 548
Vick, W. L., St. Charles, Mo..... . 562
Vliet, Daniel, Washington, N. J..... 216
Volk, Frederick A., Ware, Mass..... 88
Voorhees, C. C., Norfolk, Neb 533
Voorhis, William L., Nyack, N. Y.... 169
Wade, W. A. Massillon, O..... 375
Wagner, E. C. Girardville, Pa..... 237
Wagner, Jacob, Sidney, O..... 381
Wagner, L. J., Rome, Ga..... 326
Wait, Robert J., Greenwich, N. Y.... 149
Wakefield, W., Bath, Me..... 3
Waldron, L. R., DeKalb, Ill..... 440
Walker, Chas. K., Manchester, N. H.. 22
Walker, H. O., Idaho Springs, Colo... 595
Walker, John, Parkers City, Pa..... 257
Walker, John M., Lawrence, Kan.... 517
Walker, R. H., Eufaula, Ala 334
Walker, T. S., Gonzales, Tex..... 578
Wall, J. J., Waterloo, Ia..... 493
Wanner, Lew, Goshen, Ind..... 391
Ward, M. A., Riverside, Mass..... 79
Warde, J. S., W. New Brighton, N, Y. 162
Ware, H. S., Niagara Falls, N. Y..... 168
Warner, H. O., New Milford, Conn... 117
Warren, C. C., Waterbury, Vt.....30, 32
Warren, David, Gettysburgh, Pa..... 236
Warren, S., Newmarket, Ont. 671
Wasley, Jno., Dixon, Ill..... 440
Wasson, W. H., Fond du Lac, Wis... 464
Waston, W. J., Sterling, Ill..... 457
Waters, C. A., Adams, Mass..... 35
Watkins, Thos., Portsmouth, O..... 379
Watrous, A. G., Mystic Bridge, Conn. 122
Watson, C. H., Elkhart, Ind 390
Watson, F. W., Eureka, Kans..... 511
Watson, Jno., So. Evanston, Ill..... 457
Watties, J. D., Marshfield, Wis..... 469
Watts, J. Tayler, Jamaica, N. Y..... 154
Watts, W. H., El Paso, Tex 576
Weaver, R. F., Wadsworth, O..... 384
Weber, E. H., Menominee, Wis..... 469
Webster, F. P., Laconia, N. H..... 20
Welch, Jas. W., Astoria, Ore..... 609
Wellendorff, L., W. Berkeley, Cal.... 640
Welliver, G. W., Bloomsburgh, Pa... 223
Wellsworth, P. E., St. Johns, Mich... 427
Welton, Nelson J., Waterbury, Conn. 124
Westcott, Geo. P., Portland, Me., .. 11
Westcott, Nelson, Candalaria, Nev.. 644
Whalen, Jno. B., Sycamore, Ill..... 458
Wharton, J. R., Butte City, Mont... 552
Whelan, Wm., Elizabeth, N. J..... 201
Wheeler, N. J., Denison, Ia..... 481
Wheeler, S. N., Hancock, N. Y..... 150
Wheeler, Wm., Victoria, Tex..... 584
Wheeler, W. H., Beloit, Wis 462
Whipple, E. P., Bozeman, Mont..... 552
White A., Watsonville, Cal..... 640
White, D. A., New Carlisle, Ind... .. 396
White, R. M., Abilene, Kan..... 504
Whitelaw, John, Cleveland, O..... 365
Whitmarsh, W. W., Norway, Me.... 9
Whitner, Wm. C., Anderson, S. C... 319
Whitney, E., Anoka, Minn..... 495
Whitney, Geo. E., Stamford, Conn... 121
Whittemore, Walter J., No. Attleboro', Mass..... 73
Whittenberg, G., Cleburne, Tex..... 573
Wickham, T. A., Tioga, Pa..... .. 278
Wicks, W. B., Sharon, Mass..... 81
Wickson, Jno. J , Vancouver, B. C... 684
Wieland, L., Gladbrook, Ia..... 483
Wigal, Jas., Henderson, Ky..... 354
Willcocks, Walter, Park City, Utah 647
Wilcox, G. E., Temple, Tex 583
Wilcox, J. M., Macon, Ga..... 326
Wilcox, Wilbur, San Jose, Cal..... 635
Wilder, F. W., Woodstock, Vt..... 34
Wilken, W. A., Atlantic, Ia..... 477
Wilkinson, Jas. H., Bowling Green, Ky..... 352
Willard, J. P., West De Pere, Wis.... 475
Willard, W. H., Eau Claire, Wis..... 464
Williams, A. Plattsburgh, N. Y..... 173
Williams, Chas., Fernandina, Fla ... 328
Williams, D. D., Haverstraw, N. Y... 150
Wilhams, D. S., Ellenville, N. Y..... 141
Williams, Jas., Johnstown, Pa..... 242
Williams, J. M., Lykens, Pa..... 247
Williams, T. S., Charlotteville, Va... 300
Williams, W. H., Augusta, Me..... 2
Williams, L. L., Terre Haute, Ind.... 400
Willis, O. L., Roseburgh, Ore..... .. 613
Willis, E. S., Atchison, Kans..... 506
Willson, J. F., Pineville, Ky..... 358
Wilson, Asa, Cumberland, Md..... 329
Wilson, G. W., Vallejo, Cal..... 639
Wilson, H. G., Bellaire, O..... 361
Wilson, Jas., Gladstone, Mich..... 412
Wilson, Jas., No. Platte, Neb.. 534
Wilson, R. F., Milton, Pa..... 251
Wilson, R. H., Washington, Pa..... 282
Wilton, Wm., Litchfield, Ill..... 448



GATE OPEN.

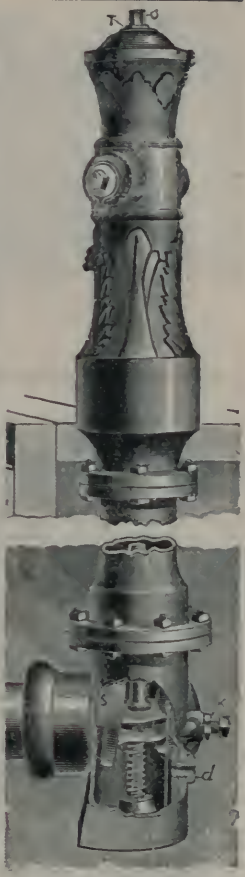
THE HOLYOKE FIRE HYDRANT,

MANUFACTURED BY

HOLYOKE HYDRANT AND IRON WORKS, HOLYOKE, MASS.

Unexcelled for SIMPLICITY, DURABILITY and LOW COST of MAINTENANCE.

All sizes made, from 4 in. with single outlet to 10-in. with six outlets, and independent gate for each outlet if desired.



GATE CLOSED.

Points of Excellence.

The gate opens down, leaving an unobstructed water way.

The gate works easily, and does not produce water hammer in closing.

All wearing surfaces are of composition.

Stones, sand or gravel in the hydrant cannot interfere with operating the gate.

It cannot freeze as it drips below the main.

The drip valve is positive in action, and cannot become clogged.

The gate remains closed in case of accident to post whereby it is broken, and a new one can be substituted without shutting the water from main.

It is carefully designed, and well constructed of the best material, so that cost of maintenance practically nothing.

Superintendents.

Wingfield, N., Chattanooga, Tenn 345
Winn, Jno., Bath-on-the-Hudson, N. Y..... 131
Winn, Jno., Greenbush, N. Y. 148
Winne, W. H., Irvington, N. Y..... 153
Wisler, C. T., Junction City, Kan..... 515
Winslow, Geo. F., Waltham, Mass..... 88
Winslow, S. J., Pittsfield, N. H..... 24
Wintler, J. R., Vancouver, Wash..... 607
Wintyen, Wm. J., Doylestown, Pa..... 230
Wires, E. L., 105 Sumner St., Boston, Mass.... 62
Wirt, R. D., Independence, Mo..... 557
Wolf, H. C., Sacramento, Cal..... 631
Wood, Chas. W., Rockville, Conn..... 119
Woodman, Frank, Charlestown, W. Va..... 311
Woodruff, Timothy, Bridgeton, N. J..... 197
Woodruff, W. T., Thomaston, Conn..... 122
Woodsworth, R., Red Oak, Ia..... 491
Woodward, F. S., No. Yakima, Wash..... 604
Worthington, C. E., Norton, Kans..... 519
Worthington, R. S., Fort Scott, Kan..... 512
Wright, A. H., Abington, Mass..... 35
Wright, H. G., Shelbyville, Ill..... 456
Wright, Millard F., Lowell, Mass..... 65
Wright, W. S., Lansing, Mich..... 419
Wyman, Geo. F., Ft. Scott, Kan..... 512
Yeaton, J. H., Palatka, Fla..... 330
York, Jno. L., Ord, Neb..... 534
Young, A. B., Kent, O..... 372
Young, Jno., Minerva, O..... 376
Zachery, R. Y., Norfolk, Va..... 306
Zehner, W. D., Lansford, Pa..... 244
Zerbe, C. A., Lewistown, Pa..... 246
Zieyle. Phil., Riverton, Neb..... 536

SECRETARIES.

[The addresses given refer to the works of which the party is secretary when no other address was reported for him.]

Adams, Geo., Plymouth, N. H..... 24
Adams, C. D., Painesville, O..... 379
Adams, W. R., Ashburnham, Mass..... 37
Affleck, Wm., Sandusky, O..... 381
Allen, C. E., Park City, Utah..... 647
Allen, Chas. P., Presque Isle, Me..... 12
Allen, Geo. D., Aberdeen, Wash..... 608
Allen, H. B., Cloquet, Minn..... 496
Allen, H. E., Binghamton, N. Y..... 132
Allen, J. V., Sheffield, Ala..... 338
Allen, W. H., Clinton, Mo..... 555
Allen, W. J., Tampa, Fla..... 331
Ambrose, F. W., Urbana, O..... 384
Anable, R. D., Lee, Mass..... 61
Andrews, D., Flint, Mich..... 411
Anderson, L. M., Los Angeles, Cal..... 622
Anderson, R. L., Ocala, Fla..... 329
Anderton, Geo. P., Talladega, Ala..... 338
Andrews, J. Frank, So. Easton, Pa..... 275
Andrews, L. L., La Conner, Wash..... 604
Andrews, L. P., Arkansas City, Kan..... 505
Andrews, R. N., Hamilton, O..... 371
Angier, G. W., Titusville, Pa..... 278
Angle, E. C., Schnectady, N. Y..... 180
Anthony, C. F., Drownville, R. I..... 97
Appleby, G. O., Sumner, Wash..... 607
Applegate, G. A., New Brunswick, N. J..... 209
Arbuckle, B. P., Highlands, Col..... 594
Armstrong, A. B., Smethport, Pa..... 275
Atherton, H. F., Scranton, Pa..... 271
Atkins, L., Port Huron, Mich..... 426
Ayers, Jno. J., Portsmouth, N. H..... 24
Bacon, E. L., Beaumont, Tex..... 571
Bailey, Geo., Columbus, Ga..... 325
Baily, Vernum A., Phenix, R. I..... 102
Baker, H. F., Bellevue, Idaho..... 618
Baker, J. H., Windom, Kan..... 525
Baker, Willard, Sharon, Conn..... 119
Baldwin, C. H., El Dorado, Kan..... 510
Baldwin, W. D., Groton, N. Y..... 149
Ballantine, David, Andes, N. Y..... 129
Bangs, E. D., Amherst, Mass..... 36
Barber, Jas., Capac, Mich..... 406
Bardwell, H. D., Turner's Falls, Mass..... 87
Barker, Wm. E., Sidney, N. Y..... 182
Barnes, L. C., St. Joseph, Mo..... 562
Barnes, R. D., Wichita, Kans..... 525
Barry, Bryan T., Corsicana, Tex..... —
Barss, A. De W., Wolfville, N. S..... 655
Bartholomew, Dana, Ansonia, Conn..... 104
Bartholomew, H. D., Lansing, Mich..... 419
Bartlett, W. H., Atlantic City, N. J..... 196
Barton, Herbert B., Centreville, R. I..... 105
Bassett, E. M., Buffalo, N. Y., 128, 131, 137, 172, 194, 195.
Bard, Ira, Northfield, Vt..... 30
Beard, Robt., Ionia, Mich..... 417
Beardall, Wm., Sanford, Fla..... 330
Beckwith, Chas. W., Fredericton, N. B..... 650
Beecher, H. A., Springfield, Ill..... 457
Bell, E. T., Passaic, N. J..... 211
Bell, L. S., Salisbury, Md..... 296
Bement, R. B. C., St. Paul, Minn..... 552
Bennett, C. E., Ticonderoga, N. Y..... 185
Bennett, G. N., Pierce City, Mo..... 561
Bennett, H. G., Pasadena, Cal..... 627
Benson, J. E., Black River Falls, Wis..... 462
Bentley, Geo. E., Chateaugay, N. Y..... 136
Bentz, S. H., Lehanon, Pa..... 245
Berkstresser, F. A., Chattanooga, Tenn..... 345
Berrian, C. M., Jeffersonville, Ind..... 392
Betz, Jas., Newport, Ky..... 357
Biggett, E. N., Beaver, Pa..... 220
Bigler, H. F., Clearfield, Pa..... 228
Billmyer, Frank P., Bloomsburgh, Pa..... 223
Binder, Wm., Saginaw, Mich..... 427
Bingay, Geo., Yarmouth, N. S..... 655
Birely, S. M., Mechanicstown, Md..... 295
Birkey, J. B., Salem, Ind..... 398
Birnie, Thos. N., Springfield, Mass..... 122, 458
Bisbee, Edw. W., Barre, Vt..... 27
Black, Geo. A., Fairhaven, Wash..... 604
Blackman, F. J., Gowanda, N. Y..... 147
Blackwell, R. C., Henderson, Ky..... 354
Blaker, Paul, Newtown, Pa..... 255
Blewett, A., Jamestown, N. Dak..... 548
Blinn, R. E., Steubenville, O..... 382
Bloom, W. H., Williamsport, Pa..... 285
Blum, Jr., Philo B., Chatham, N. Y..... 136
Bond, C. H., Bridgeport, Conn..... 109
Bond, Edw. A., Watertown, N. Y..... 665, 671
Booker, H. R., Hampton, Va..... 302
Boon, T. R., Salem, Va..... 309
Booth, N. N., Knox, Pa..... 243
Borden, R. A., Moneton, N. B..... 651
Bostwick, H. W., Franklin, Pa..... 235
Bourgeois, L. E., Longueuil, Que..... 658
Boyd, H. J., Chicopee Falls, Mass..... 49
Brace, J. C., Chase, Mich..... 407
Braley, E. A., Tulare, Cal..... 638
Brewer, G. R., Redondo Beach, Cal..... 636
Brewer R., Independence, Ia..... 48
Brewer, R. J., Centinela, Cal..... 61
Bryce, T. N., Troy, O..... 38
Briggs, C. F., New Lisbon, O..... 37
Briggs, G. C., Miller, So. Dak..... 54
Brigham, J., Ulysses, Pa..... 28
Brinsmade, D. S., Birmingham, Conn..... 12
Brittain, A. R., East Stroudsburgh, Pa..... 28
Broatch, J. C., Middletown, Conn..... 11
Brock, E. F., Mammoth Spring, Ark..... 67
Brocksmit, J. C., Cedar Rapids, Ia..... 47
Brooks, Jno. M., Knoxville, Tenn..... 34
Brown, B. J., Menominee, Mich..... 4
Brown, Chas. K., Deposit, N. Y..... 1
Brown, John H., Bristol, N. H..... 2
Brown, Jno. S., Stroudsburgh, Pa..... 4
Brown, S. D., Lapeer, Mich..... 1
Bruyn, C. D., Kingston, N. Y..... 1
Bruyn, Chas. D., Fort Plain, N. Y..... 6
Bryan, Edgar, Seattle, Wash..... 2
Bryden, A. A., Pittston, Pa..... 3
Bryson, H. K., Fayetteville, Tenn..... 3
Buck, I. D., Plymouth, Ind..... 1
Buckley, Dan'l J., Galveston, Tex..... 1
Buderlinden, Edw., College Point, N. Y..... 1
Bukford, Wm., Missoula, Mont..... 1
Bulkley, N. T., Danbury, Conn..... 1
Bull, E. L., Anderson, Cal..... 1
Bunn, H. B., Rahway, N. J..... 1
Bunn, Wm. S., Sturgis, Mich..... 1
Burbank, A. L., San Gabriel, Cal..... 1
Burbank, C. O., Wakefield, Mass..... 1
Burgar, J. H., Welland, Ont..... 1

The National Tube Works Co.

MANUFACTURER OF

Standard, Steam, Gas and Water Pipe; Lap-Welded Boiler Tubes; Mack's Patent Injector; Natural Gas Line Pipe; Artesian Salt and Oil Well Tubing and Casing; Drive Pipe; Tubes; Heavy Flush Joint Tubing; Inserted Joint Casing; Hydraulic Lap-welded Tuyere Pipe; Light Flanged Pipe; Pump Columns; Harvester Pipe; Railroad Tubular Goods; Specialties for Gas, Oil, Water and Natural Gas System, etc.

WORKS: McKeesport, Pa., and Boston, Mass.
OFFICES AND WAREHOUSES: Boston, Mass.; New York, N. Y.; Philadelphia, Pa.; Pittsburg, Pa.; St. Louis, Mo.; Chicago, Ill.

CONVERSE PATENT LOCK JOINT PIPE.

Water and Gas Works System.

During the past few years the National Tube Works Company have made wonderful progress in the introduction of their Converse Patent Lock Joint Water and Gas Works Systems, having introduced it to hundreds of cities and towns for complete systems and extensions, and practically demonstrated the manifold advantages of wrought iron, properly protected from the influences of corrosion, prominent among which are: Strength of Material, Durability, Serviceability, Decreased Frictions. (Prof. Chas. H. Haswell gives his opinion that Converse Joint Pipe has a comparative advantage of fully 25 per cent. over spigot and faucet jointed cast-iron pipe in delivering capacity, and this has been greatly exceeded by practical tests.) Economy in lead, freight, labor, etc., etc. The mills of the Company at McKeesport cover fifty-two acres and they employ over 5,000 men, making their own special re-worked iron for this class of pipe direct from the ores, having their own foundries, and in fact every department necessary for turning out the finished product complete.

The Converse hub is cylindrical in shape and strictly in conformity with diameters of the pipe. By means of its peculiar construction, provision is made for expansion and contraction. As will be seen from the illustration, wedged-shaped spaces are provided for the reception of the lead, which is poured and finally calked, as hereinafter described, into recesses which the lugs or rivets enter, and an annular ring, against which the ends of the pipes butt, forming a flush and smooth interior of a continuous diameter with the inside of the pipe.

The special pipe is known by its exact outside diameters; is made of special grade of superior fibrous iron, capable of withstanding excessively high pressure and finished to such a nicety that it enters the Converse Hub and meets the inner ring of the hub with accuracy. After being thoroughly tested by hydrostatic pressure, tapped with a hammer while under pressure and proven perfect, the plain ends receive two strong rivets each, which enter the recesses in the joint, straight, then being locked into position, right or left, as the case may be. The joint is then ready to receive the lead calking.

The simplicity of the connection and the ease and rapidity with which it can be laid can be readily appreciated. The complete line of fittings comprise connections of every possible description, and the specially designed tools and appurtenances embody lightness with great strength and simplicity. They consist of service clamps, combination pouring and locking clamps, bending machines, drilling and tapping machines, calking tools, etc., etc. Most of the noted expert chemists and engineers have pronounced the protections afforded the plain wrought iron against the attacks of all acids and alkalies found in nature, perfection of completeness in the matter of durability. After the plain pipe is thoroughly cleansed, it is treated with the Kalamein alloy (largely composed of tin) and afterward subjected to a very tenacious bath of special Asphaltum, composed of the very best Trinidad asphaltum, oils, gums and a strong varnish mixture, all anti-corrosive to the highest degree. Space will not permit of extended details, but full data and illustrations are cheerfully furnished by addressing the National Tube Works, through any of their many branches or agencies.

Secretaries.

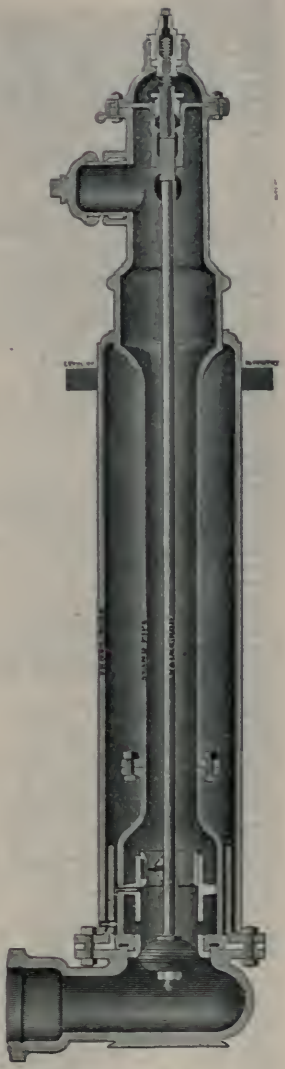
Burnell, G. W., Oshkosh, Wis. 471
Burnham, Albert L , Revere, Mass. 79
Burnham, F. W., Fergus Falls, Minn. 497
Burritt, D. B., Stratford, Ont. 675
Burwell, D. S., Norfolk, Va. 306
Burwitz, O. K., Temple, Tex. 583
Butcher, F. J. Hopedale, Mass. 69
Butchert, N., N. Y. City. 341
Butler, J. S., Syracuse, N. Y. 184
Cahoone, W. B., Red Bluff, Cal. 629
Camp, A. H., Norwalk, Conn. 117
Cander, H. N., Waterville, N. Y. 190
Capps, W. E . Jacksonville, Ill. 445
Carpenter, Edwin H., Claremont , N. H. 16
Carpenter, John O., Phillipsburgh, N. J. 212
Carroll, D., Riverside, Cal. 631
Carscaddan, J., Muscatine, Ia. 489
Carter, Frank, Pottsville, Pa. 236
Cary, J. B., Middlesborough, Ky. 356
Case, L. N., Detroit, Mich. 409
Case, Geo. W., Amesbury, Mass. 36
Caton, C. A., Ottawa, Ill. 451
Catton, H. R., San Rafael. 635
Caulfield, Jno., St. Paul, Minn. 502
Chadbourn, E. J., Holbrook, Mass. 57
Chamberlain, J. F., Stafford Springs, Conn. 121
Chamberlain, J. W., Plymouth, Mass. 266
Chamberlain, Martin, Prattsville, N. Y. 175
Chamberlayne, J. K., Utica, N. Y. 187
Champion, J. M., Ellsworth, Kan. 511
Champlin, Tint., Little Valley, N. Y. 158
Chapin, Geo. L., Lincoln, Mass. 63
Chapin, I. C., Oneida, N. Y. 170
Chapman, E. C., Plainville, Conn. 118
Chapman, W. S., East Portland, Ore. 610
Chase, F., Anoka, Minn. 495
Chase, F. K., West Liberty, Ia. 494
Chase, J. A., Saint Cloud, Minn. 501
Chase, J. Seymour, Hartford, Conn. 112
Chase, P. B., Mt. Vernon, O. 377
Chase, Wm. M., Concord, N. H. 17
Chester, A. L., Wellington, Kan. 524
Childs, W. H., Manchester, Conn. 113
Church, G. M., Athens, Ga. 322
Churchill, C. W., Mt. Pleasant, Mich. 422
Churchill, E. S., Napa City, Cal. 624
Clark, D. M., Elyria, O. 370
Clark, J. C., Columbia, Pa. 228
Clark, T. A. Springvale, Me. 14
Clark, W. H., Big Rapids, Mich. 406
Clarke, Wm. H., Contral City, Ky. 352
Clark, Wm. H., New Castle, Del. 288
Clarke, Ben. S., Holdredge, Neb. 531
Clausen, C. C., Washburn, Wis. 475
Cleveland, J. E., Canton, Pa. 225
Clinard, S. M., Salem, N. C. 317
Clunk, H. F., Marion, Ind. 395
Clute, F. P., So. Pittsburgh, Tenn. 350
Cochran, Sam'l, Park Ridge, Ill. 452
Codd, Wm. F., Nantucket, Mass. 70
Coffin, G. H , Asbury Park, N. J. 195
Coffman, N. B., Chehalis, Wash. 603
Cole, M. N., Castile, N. Y. 136
Collier, J. M., Fresno. Cal. 619
Collins, W. E., Ontario, Cal. 626
Collman, O. J., Broken Bow, Neb. 528
Comstock, A. W., Alpina, Mich. 403
Conant, Whitney, Long Branch, N. J. 206
Conaway, Y. T., Cañon City, Col. 588
Conklin, A. R., Independence, Cal. 621
Conner, Geo. M., Cheboygan, Mich. 408
Cook, C. F., Bellefonte, Pa. 221
Cooke, E. D., Arch Beach, Cal. 615
Cooley, Wm. V., Lambertville, N. J. 205
Coon, C. P., Hudson, Wis. 466
Coon, E. A., Upper Sandusky, O. 384
Coop, F., Monticello, Ia. 488
Cooper, A. R., Louisville, Ky. 356
Cooper, Geo. F., Xenia, O. 386
Cooper, J. B., Smyrna, Del. 288
Cooper, Wm. E., Gr. Barrington, Mass. 55
Corley, Jno. R., Mexia, Tex. 580
Cornell, W. T., Mamaroneck, N. Y. 161
Corscot, Jno., Madison, Wis. 468
Cosgrove, G. H., Oscoda, Mich. 424
Costar, W. J., Chico, Cal. 617
Couch, Frank, Selma, Cal. 637
Coulter, D. P., Mayfield, Ky. 356
Counell, W. H., Ebensburgh, Pa. 232
Cowan, Jessie B., Hancock, N. Y. 150
Cowell, J. P., Bangor, Pa. 220
Cowell, T. E., Muscatine, Ia. 485, 493
Craft, Alfred, Conshohocken, Pa. 229
Craig, B. E., Ellensburgh, Wash. 603
Craighead, J. B., Richmond, Ind. 397
Crane, Benj., Crawfordsville, Ind. 389
Crane, S. H., Hornellsville, N. Y. 152
Crane, W. H., Port Jervis, N. Y. 174
Cranny, Theo., Coupeville, Wash. 603
Crawford, O. Y., Toronto, O. 387
Crebassa, Jno., Sorel, P. Q. 663
Crosby F., Montgomery, Ala. 337
Croscup, Geo. E., Short Hills, N. J. 214
Crow, W. H. B., Eagle Rock, Ida. 648
Crozier H. S., Zanesville, O. 387
Cruft, J. W., Terre Haute, Ind. 400
Cruise, J, D., Argentine, Kan. 505
Crysler C. S., Independence, Mo. 557
Cunningham, W. B., Tr nidad, Colo. 599
Cunningham, W. W., Clinton, Ia. 480
Currier, Orlando, Hallowell, Me. 8
Curtis, C. F. Susquehanna, Pa. 276
Cushman, H. D., Three Rivers, Mich. 429
Dana, S. A., Nipomo, Cal. 625
Daniels, Frank K., Towanda, Pa. 278
Darling, Edward, Providence, R. I. 101
Davis, J. T., Waco, Tex. 585
Davis, Jno. D., St. Louis, Mo. 506
Davis, M. M., Reynoldsville, Pa. 268
Davis, Saml. D., Lakewood, N. J. 205
Davis, Wm., Anniston, Ala. 332
Dawson, Wm. R., Tidioute, Pa. 277
Dean, C., Annville, Pa. 285
Dean, Geo., Cheshire, Mass. 43
Deane, Sydney, Bristol, R. I. 97
Decker, J. H , Salina, Kans. 522, 526
Deckerman, A. E., Gt. Falls, Mont. 552
Demarest, B. B., Ellenville, N. Y. 141
Denison, F. W., Bayfield, Wis. 462
Denman, A. N., Des Moines, Ia. 482
Denny, C. P., Marysville, Mo. 560
Deverest, W. C., White Bear, Minn. 406
Dewy, F. H., Manlius, N. Y. 161
Dickinson, T. P., Glasgow, Ky. 354
Dickson, Theo., Sewickley, Pa. 272
Diehl, J. W., Pt. Chester, N. Y. 174
Diven, J. M., Elmira, N. Y. 142
Dobson, R. B., 2 Wall St., New York City. 375
Dodge, J. E., Racine, Wis. 473
Donahue, Jas. P., Davenport, Ia. 481
Dorrance, G. M., Bristol, Pa. 224
Douglas, W. B., Fargo, N. Dak. 546
Douty, F. S., Pacific Grove, Cal. 627
Dowe, M. P., Danielsonville, Ct. 110
Downard, J. A., Danville, Ind. 402, 460
Downes, F. W., Superior, Wis. 474
Doyle, F. P., Petaluma, Cal. 628
Doyle, W. B., Camden. N. J. 200
Drinkwater, J. H., Palmer Lake, Col. 957
Dunbar, E. L., Bay City, Mich. 405
Dunford, P. C., New London, Conn. 116
Dunn, A. W., Pulaski. N. Y. 175
Durham, R. G., The Dallas, Ore. 613
Dwight, Jas., La Grand, Ore. 611
Eastabrook, E. R., Hoosick Falls, N. Y. 152
Eaton, C. A., Kent, Conn. 112
Eaton, F. W., Southbridge, Mass. 81
Eaton, Wm., Kentville, N. S. 634
Eby, S. G., Weatherly, Pa. 283
Eddy, S. A., Canaan, Conn. 109
Edginton, S. R., Eldora, Iowa. 483
Edson, T. H., Glenwood Springs, Col. 593
Edwards, C. H., Sioux City, Ia. 491
Edwards, F. H., Hart, Mich. 415
Edwards, J., Fremont, O. 37
Edwards, Wm., Findlay, O. 376
Egan, Jr., Peter, Le Mars, Ia. 488
Egerton, L., Carbondale, Pa. 22
Elam, J. L., Milton, Ore. 61
Eldred, N. B., Auburn, N. Y. 12
Elford, A. B., Winnipeg, Man. 68
Elliott, Geo., Seabright, N. J. 21
Ellis, W. F., Decatur, Ala. 33
Elwood, J. O., London, Ont. 67
Espy, B. M., Wilkesbarre, Pa. 28
Evans, Fred W., Cote, Saint Antoine, P. Q. 6
Evans, Jas. G., Thomasville, Ga. 32
Everett, Jno., Canton, Mass. 4
Ewer, F. S., St. Helena, Cal. 6
Fairbairn, A., Berthoud, Col. 5
Farnsworth, H. M., 219 Superior St., Cleveland, O. 3
Farr, Edw., Wenonah, N. J. 2
Fatio, Henry, New Rochelle, N. Y. 1
Faxon, W. L , Quincy, Mass. 3
Fecker, L., Kenton, O. 3

BOURBON
Copper & Brass
WORKS.

PATENTED
FIRE
Hydrant
AND
STOP
Valves,

ALSO MFRS. OF
Copper and Brass
GOODS
OF
Every Description.

198, 200, 202, 204
E. FRONT ST.,
CINCINNATI, O.



GATE VALVES,
Brass and Iron,
FOR
Water, Steam, Gas and Oil.
Globe, Angle, Check, Radiator and Safety Valves.

D. KENNEDY
Manufacturer,
52 Cliff St., New York
☞ Send for New Catalogue.

OUR ECLIPSE
HYDRAULIC ELEVATOR
Is Absolutely Safe.

No Ropes or Cables.

Cannot Fall or Freeze.

Send for Catalogue.
Tuerk Hydraulic Power Co.,
CHICAGO. NEW YORK.

Secretaries.

Felker, C. H., Avon, Mass. 38
Fellows, W. B., Tilton, N. H. 25
Felt, J. P., Emporium, Pa. 233
Feraud, Fulton G., Redlands, Cal 680
Ferguson, J., Independence, Kan 515
Ferguson, Mrs. Jno., Sonora, Cal. 637
Ferguson, S. W., Worcester, N. Y. 192
Ferguson, Walter, Stamford, Conn 121
Ferris, J. F., Grafton, Mass. 55
Field, Lottie A., Cooperstown, N. Y. 180
Fields, P., Canton, O. 362
Filler, L. A., Columbus, O. 367
Filmore, W. S., Gaylord, Mich. 412
Finkbiner, U. S. G., Royersford, Pa. 269
Fish, H., Michigan City, Ind. 395
Fisher, Albert P., Montclair, N. J. 206
Fisher, Chas. H., Booth Bay Harbor, Me. 4
Fisher, R. J., Athens, Tenn. 344
Fisk, J. A., Ansonia, Conn. 106
Fisk, Thos. E., Gorham, N. H. 19
Fitch, Chas., Mt. Clemens, Mich. 422
Fitch, G. W., Walton, N. Y. 187
Fitts, W. C., Tuscaloosa, Ala. 339
Fletcher, D. A. Maquoketa, Ia. 487
Fletcher, H. B., Gainesville, Tex. 557
Flint, Joseph A., San Diego, Cal. 632
Floyd, F. A., Brewer, Me. 4
Floyd, J. B., Waverly, N. Y. 190
Fogg, E. W., Oroville, Cal. 626
Foote, Ellsworth I., New Haven, Conn. 115
Forbes, Murray, Greensburgh, Pa. 237-241
Forbes, W. E., Morrisonville, Ill. 450
Ford, Edgar W., Lowell, Mich. 419
Foster, E. P., Ventura, Cal 639
Foster, Henry, Silver City, N. M. 602
Foster, J. A., Calvert, Tex. 673
Fowler, E., Kingman, Kans. 516
Fox, Cyrus T., Reading, Pa. 268
Fox, Geo. H., Kittaning, Pa. 252-282
Francis, J. T., New Brighton, N. Y. 162
Franklin, R. S., Newport, R. I. 98
Fraser, L. C., Menlo Park, Cal. 622
Fritz, D. E., Lima, O. 373
Fry, A. C., Arlington, Ore. 609
Fry, C. W., Hot Springs, Ark 568
Fuller, A. O., Exeter, N. H. 18
Fuller, F. L., 12 Pearl St., Boston, Mass. 90
Gage, W. C., Battle Creek, Mich 404
Gamble, Fred. S., Camden, N. Y. 134
Gamwell, C. K., Palmer, Mass. 75
Gangham, T. J., Camden, Ark. 567
Gardiner, J. M., Phœnix, Ariz. 642
Gardiner, S. W., Lyons, Ia. 486
Gardner, F. B., Brockton, Mass 43
Gardner, P. V., Peru, Ind. 397
Gates, Chas O., Greenport, N. Y. 149
Gates, C. O., Sag Harbor, N. Y. 178
George, C. H., Bartlett, N. H 16
Gerber, E. B., Ligonier, Ind. 394
Gerhard, H. E., Philadelphia, Pa. 308
Getchell, W. H., 317 11th Ave., So. Minneapolis, Minn. 497
Gilbert, A., Minneapolis, Kan. 519
Gilbert, S. J. R., Redding, Cal. 629
Gilbert, Y. C., Whitman, Mass. 93
Gildersleeve, Jr., Henry, Portland, Conn. 119
Gilligan, H. M., N. Y. City 143, 483
Gilpatrick, G. S., Granville, O. 371
Gleason, S. S., Watertown, Mass. 89
Glover, C. W., Joplin, Mo. 558
Godfrey, C. O., Ft. Payne, Ala. 335
Goff, J. M., Pittsburgh, Kan. 522
Goryas, A. B., Crookston, Minn. 496
Gosser, J. J., Emlenton, Pa. 233
Gould, A. H., Ashland, Neb. 527
Gould, Wm., Morrisville, Vt. 30
Graham, W. I., Newton, Kan. 519
Graham, W. M., Paoli, Pa. 286
Graham, W. M., Spring Garden, Ala. 338
Grant, Jr., W. H Sandstone, Minn. 502
Graves, Wm., Corvallis, Ore. 610
Gray, J. R., Waukesha, Wis. 476
Gray, L. E., Albany, Ore. 609
Greathead, Wm. E., Newark, N. J. 208
Greely, Jas., Shelbyville, Ind. 399
Green, Chas. E., Lawrenceville School, Lawrence, N. J. 205
Greenleaf, F. S., Savanna, Ill. 456
Griffin, J. C., Skowhegan, Me. 13
Grinnell, Geo. E., Mystic Bridge, Conn. 122
Grinnell, Wm., Ravenna, O. 380
Grohe, John S., Wilmington, Del. 283
Grose, Wm. R., Rockland, Mass. 79
Gross, A., McPherson, Kan. 518
Grow, C. A., San Francisco, Cal. 640
Grun, January, Lebanon, Ky. 354
Guiberson, C. E., Kent, Wash 604
Guy, Jas. P., Carbonear, Nfd. 656
Haight, T. M., Waukesha, Wis. 475
Halbach, Jacob, Lancaster, Pa. 244
Hall, C. L., Marshall, Mo. 560
Hall, E. D., Stuttgart, Ark. 570
Hall, E. S., Merchantville, N. J. 206
Hall, Geo., Leominster, Mass. 62
Hall, J. B., Brunswick, Ga. 324
Hall, O. L., Wolcottville, Ind 401
Hall, W. H., Omaha, Neb. 534
Hamilton, W. S., Roseburgh, Ore. 613
Hammond, Jr., J. C., Rockville, Conn. 119
Hanford, Chas. A., Hobart, N. Y. 151
Hand, Geo. B., Scranton, Pa. 272
Hand, H. C., Honesdale, Pa. 240
Hand, Peter B., Randolph, Mass. 78
Hannan, Thos., Suspension Bridge, N. Y. 183
Harder, Geo. D., Cobleskill, N. Y 137
Harding, Henry, Tunkhannock, Pa. 279
Harding, H. H., Carthage, Mo 555
Harlow, Edw. J., Wilkinsburgh, Pa. 284
Harlow, Geo. R., Pittsburgh, Pa. 135
Harmes, G. R., Belleview, Ky. 352
Harris, R. O., Bridgewater, Mass. 42
Harrison, H. H., Stillwater, Minn. 503
Harrison, J., Wellsborough, Pa. 283
Harrison, L., Lake City, Fla. 329
Harrison, O. W., Clyde, O. 367
Hart, D. M., Benicia, Cal. 616
Hart, G. A., Manistee, Mich. 420
Hartz, M., Eagle Pass, Tex. 576
Haskell, Jno. C., Lynn, Mass. 66
Hassen, H. C., Lewiston, Ill. 447
Haupt, J., Trackville, Pa. 235
Hawkins, T. S., Hollister, Cal. 621
Hawley, C. T., Cambridge, N. Y. 134
Hayes, A., Lewisburgh, Pa. 246
Hayes, W. K., Parsons, Kan 521
Haynes, Felix G., Andover, Mass. 36
Hays, O. L., Galion, O. 371
Hazleton, E. J., Kenosha, Wis. 467
Healy, W. C., Ridgway, Pa. 269
Heath, H. M., Augusta, Me. 6
Heath, R. W., Austin, Nev. 643
Heath, W. P., Weir, Kan. 524
Hemphill, Jno. W., Tarentum, Pa. 277
Henry, D. C., Marion, O. 374
Henshaw, Geo. W., Winston, N. C. 318
Herbig, Chas. A., Dayton, O. 368
Hershey, B. H., Manheim, Pa. 248
Hewitt, Wm. I., Leavenworth, Kan 517
Hewson, J. H., N. Y. City 488
Highlands, S. M., Pittsburgh, Pa., 341, 345, 378, 441, 485, 534, 537.
Hihn, Aug. C., Santa Cruz, Cal. 636
Hildreth, C. G., 45 B'way, N. Y. City 372
Hill, G. M., Freeport, Pa. 236
Hill, H. C., Thermalito Colony, Cal. 638
Hill, Wm. F., Dedham, Mass. 52
Hilts, W. C., Rock Rapids, Ia. 491
Hinckley, H., Cairo, Ill. 434
Hinckley, H., Williamsport, Pa. 240
Hinckly, H., Selin's Grove, Pa. 272
Hindekoper, E., Meadville, Pa. 249
Hiscock, C. E., Ann Arbor, Mich. 404
Hobart, Nathl. P., Goldsborough, N. C. 316
Hodgkins, H. C., Syracuse, N. Y. 665, 668
Hoffman, Adam, Crestline, O. 367
Holbrook, L. C., Charlotte, Mich. 407
Holden, A. R., Honeoye Falls, N. Y. 151
Holland, A. B., Alexander, Ark 566
Holland, G. H., Mendota, Ill. 418
Holland, Jas. Frank, Houlton, Me. 8
Hollingsworth, G. S., Bowling Green, Ky. 352
Holman, Sam'l W., Hillsborough Bridge, N. H. 20
Holme, Richard, Denver, Colo. 591
Holmes, C. M., Sequin, Tex. 582
Holmes, H. S., Lansingburgh, N. Y. 156
Home, V. W., Gardner, Mass. 54
Hommann, C. C., Perth Amboy, N. J. 212
Honeyman, A. B. D., Somerville, N. J. 214
Hopkins, B. D., Saint Albans, Vt. 31
Hopkins, D., San Marcos, Tex. 582
Hopkins, Jr., W. S., Council Bluffs, Ia. 480
Hoppock, T. E. S., Tremont, Mich. 412
Horton, E. S., Olympia, Wash. 604
Hotchkiss, C. M., Whitehall, N. Y. 191
Houghton, E. L., Ft. Fairfield, Me. 7
Houghton, J. H., Tacoma, Wash. 607

AIR COMPRESSORS

FOR

AERATING WATER.

For permanent compressor plants for aerating and purifying water there is nothing to equal our duplex compressors fitted with Corliss engines, simple, condensing or compound, and our new mechanical air valve gear.

The attention of water departments of cities and towns and of water companies is called to this method of purifying water, which is already in successful use on a large scale. For particulars and circulars, address

RAND DRILL CO.,

23 Park Place, New York.

THE NEW HIGH EXPLOSIVE

RACKAROCK

Furnished in two ingredients which are absolutely inexplosive until combined by the consumers, for which we furnish convenient means. Shipped and stored as ordinary merchandise. After combination the explosive is far safer than any other. By reason of its safety it is specially adapted to water-works construction in crowded streets and the widening of railway cuts, through which trains are moving.

RENDROCK POWDER CO.,

23 Park Place, New York.

Secretaries.

Houghton, W. E., Bakersfield, Cal. 616
Howard, Chas., Rogers Park, Ill. 455
Howard, G. C. Addison, N. Y. 127
Howe, A. C., Whitesville, N. Y. 192
Howland, B. W., Tyler, Tex. 584
Hubbell, C. H., E. Tawas, Mich. 410
Hubbell, Fred. B., 1225 Calvert st., Baltimore, Md. 316
Huber, A. H., Westminster, Md. 296
Hudson, A. H., Harrison, Mich. 415
Hughes, Alex., Bismarck, N. Dak. 546
Hughes, L. W., Parkersburg, W. Va. 313
Hughes, M. B., Shickshinny, Pa. 274
Hungary, E. C., New Albany, Ind. 396
Hunter, Jno. F. Baltimore, Md. 292
Hurlbut, J. L., Santa Barbara, Cal. 636
Hussey, E. E., Sanford, Me. 13
Hutchings, W. S., Jermyn, Pa. 241
Hutchins, J. B., Little Falls, Minn. 408
Hutchinson, D. P., Charlotte, N. C. 315
Iglehart, J. Harwood, Annapolis, Md. 290
Ingalls, G. W., Natick, Mass. 70
Irwin, H. T., Neola, Ia. 489
Irwin, Wm. E., Phillipsburgh, Pa. 264
Janett, H. W., Emaus, Pa. 233
Jenks, B., Sand Beach, Mich. 428
Jewell, Calvin H., Catskill, N. Y. 136
John, S. W., Selma, Ala. 338
Johnson, A., Orlando, Fla. 329
Johnson, D. F., Bastrop, Tex. 585
Johnson, John, Lanesboro, Minn. 498
Johnson, J. W., Windsor Locks, Conn. 125
Johnston, W. A., Latrobe, Pa. 245
Jones, A. N., Larned, Kan. 516
Jones, I. F., Clifton Heights, Pa. 286
Jones, J. A., Marion, Kan. 518
Jones, J. Ira, Newbern, Tenn. 351
Jones, W. H., Holly, Mich. 416
Jordan, N. J., Auburn, Me. 1
Joron, R. S., Valleyfield, P. Q. 663
Kear, Charles R., Minersville, Pa. 251
Keefe, A. O., Moberly, Mo. 561
Keene, C. E., New Rochelle, N. Y. 156
Kellogg, R. C., Elizabethtown, N. Y. 141
Kelly, Timothy, Norwich, Conn. 118
Kemumier, Wm., Hero, Pa. 269
Kendlehart, J. W., Gettysburgh, Pa. 236
Kennedy, A. H., Rockport, Ind. 398
Kennedy, F. C., Winooski, Vt. 34
Kern, J., Marquette, Mich. 420
Kerr, J. C., Oxford, Pa. 257
Kimball, Chas. E., 3 Pine stret, N. Y. City, N. Y. 201, 361, 384, 505
Kimball, D. A., Stockbridge, Mass. 85
Kimball, N. W., Dubuque, Ia. 482
Kindle, R. W., Weatherford, Tex. 585
King, A. W., Ellsworth, Me. 7
King, Jno. H., Belvidere, N. J. 196
Kingsland, Edw., Geneva, N. Y. 146
Kirkham, Jno. S., Newington, Conn. 116
Kirkpatrick, Geo. E., Philadelphia, Pa. 237
Knapp, Chas. L. Lowell, Mass. 65
Kniffin, A. T. Cohoes, N. Y. 138
Knight, J. E., Houston, Tex. 578
Knowles, S. M., E. Greenwich, Conn. 98
Knowlton, Hiram, Kankauna, Wis. 463
Koons, J. B. D., Harrisburg, Pa. 239
Kopp, A. C., Chillicothe, O. 363
Koppenheimer, Jno., Muskegon, Mich. 423
Kreuse, F. E., West Point, Neb. 538
Kriebel, H. S., North Wales, Pa. 256
Kuhn, W. S., Pittsburgh, Pa., 393, 469, 471, 473, 532, 514, 569
Kunkle, Frank, Nazareth, Pa. 254
Laferriere, J. C., Hull, P. Q. 658
Laidley, W. S., Charleston, W. Va. 311
Lamson, D. L., Fryeburg, Me. 7
Lane, C. J., Bradford, Pa. 224
Lane, H. H. Canandaigua, N. Y. 135
Langford, Jno. T., Mason B'd'g, Boston, Mass. 23
Larrabee, Seth L., Portland, Me. 6
Lautz, Henry, Pekin, Ill. 452
Law, Thos., Archibald, Pa. 219
Lawton, H., El Paso, Tex. 576
Layton, Jacob M., So. Norwalk, Conn. 121
Leatherberry, J. M., Middletown, Del. 287
Lee, H. C., Pineville, Ky. 358
Le Fever, John Z., Olean, N. Y. 170
Lent, Frederick, Peekskill, N. Y. 172
Libbey, Jr., W., Princeton, N. J. 213
Liekert, A. C., East Hartford, Conn. 126
Lightner, Wm. H., St. Paul, Minn. 500
Lindsay, N. T., Covington, Ky. 353
Little, Edmond, Laconia, N. H. 20
Lewellyn, J. F., Mexico, Mo. 561
Lockwood, Jno. C., Jamaica, N. Y. 153, 154, 172
Long, R. A., Columbus, Kan. 509
Loomis, Geo. F., Attica, N. Y. 129
Lottman, W. P., Sprague, Wash. 606
Love, Ben, Truckee, Cal. 638
Lovell, R. P., Tybee, Ga. 327
Low, D. W., Gloucester, Mass. 55
Loyd, Jos., Ironton, O. 372
Lubke, T., Victoria, B. C. 681
Lucas, A., Calgary, N. W. Ter. 681
Ludwig, C. B., 72 Broadway, New York City, 21, 360, 456, 517, 533
Lundit, Wayne, Champaign, Ill. 436
Lyman, H. H., Oswego, N. Y. 171
Lyon, C. A., Farwell, Mich. 411
McClumpha, John, Amsterdam, N. Y. 128
McClure, A. H., Frankfort, Ky. 353
McConnel, H. S., New Brighton, Pa. 254
McCormick, S. M., Lock Haven, Pa. 246
McCormick, W. B., Uniontown, Pa. 280
McConnico, A. D., Bryan, Tex. 572
McCoy, A. J., Rochester, Pa. 286
McCoy, T. F., Lewistown, Pa. 246
McCray, P. E., Greenville, Pa. 238
McCreery, H. C., Colorado Springs, Col. 589
McCue, W., Ottumwa, Ia. 491
McCusker, J. E., Newburyport, Mass. 72
MacDonald, A., Athol, Mass. 37
McDonald, Edw., Lenox, Mass. 62
McDonald, P. J., Ft. Wayne, Ind. 391
McDowell, B. R., Bristol, Tenn. 344
McDowell, Geo., Slatington, Pa. 274
McDowell, T. S. O., Fairbury, Ill. 442
McFarland, J. W., Vancouver, B. C. 683
McGovern, S., Logansport, Ind. 394
McGuire, J. M., Belleville, Ill. 433
McHenry, Ora, Modesto, Cal. 623
McKenzie, T. H., Southington, Conn. 120
McLain, C. F., Omaha, Neb. 530
McLaughlin, Jr., J. S., Wyandotte, Mich. 430
McLean, Duncan, Charlottetown, P. E. I. 656
McMahon, E. B., Anderson, Ind. 388
McManus, Peter., Denver, Colo. 591
Macmurdo, R. S., New Orleans, La. 343
Macrae, B. W., Clarksville, Tenn. 345
McNall, Geo. G., Greenwhich, Conn. 111
McNamee, J. L., Cooperstown, N. Y. 139
McNeil, Chas. L., Torrington, Conn. 123
McNutt, H. M., Bessemer, Ala. 333
McReady, Jas., Summit, Hill, Pa. 276
Madigan, Jno., Dunkirk, N. Y. 141
Madison, W. A., Cleveland, O. 366
Maguire, J. W., New York City. 512
Maneval, S. H., East Palastine, O. 369
Marks, Sam'l Arkansas City, Ark. 567
Marsh, E. V., New Bethlehem, Pa. 254
Martin, B. M., Brookville, Pa. 224
Martin, C. A., Altoona, Pa. 219
Martin, F. M., Palouse, Wash. 605
Martin, J. M., Salem, Ore. 613
Martin, R., Laredo, Tex. 579
Martin, T. F., Walsenburg, Colo. 600
Martz, Geo. O., Shamokin, Pa. 273
Mason, R. H., Seville, Fla. 331
Mason, W. B. R., Bound Brook, N. J. 199
Mathews, Chas., Toronto, Ont. 678
Matthay, O. C., Cucamonga, Cal. 618
Maxcy, Josiah S., Gardiner, Me. 5, 8, 12, 651
Maxwell, J. H., Pottstown, Pa. 266
Maxwell, Wm., Fonda, N. Y. 143
Mead, Wm. H., Oakland, Cal. 625
Meek, E. E., Marysville, Cal. 622
Meister, Wm., Gladbrook, Ia. 483
Mercer, A. G., Waterloo, N. Y. 189
Meredith, W. B., Kittanning, Pa. 225, 243, 281
Merrill, E. W., North East, Pa. 256
Metzler, S. J., Crested Butte, Col. 590
Meyer, Geo. S., Waynesborough, Pa. 283
Meyers, J. E., Oceanside, Cal. 626
Miller, H. A., Vassar, Mich. 429
Miller, H. G., Punxsutawney, Pa. 267
Miller, Johnson, Lititz, Pa. 246
Miller, P., Hudson, N. Y. 152
Miller, T. De Witt, No. Tarrytown, N. Y. 169
Miller, Wm. C., Newburgh, N. Y. 163
Miller, W. W., Cascade, Colo. 588
Milham, Frank, Otsego, Mich. 425
Milner, W. J., Birmingham, Ala. 333
Mitchell, J. S., Martin's Ferry, O. 375
Moffett, Chas. T., Syracuse, N. Y. 162, 461
Molrett, Z., Wooster, O. 386

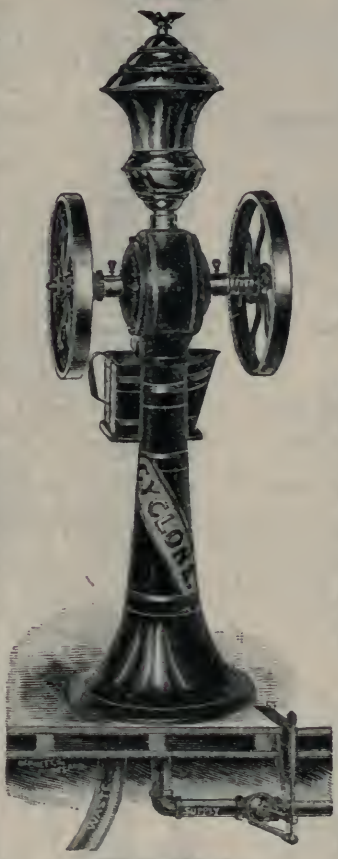
The "Cyclone" Coffee Mill.

The "CYCLONE" Mill grinds from 3 to 6 lbs. of Coffee in a minute (according to water pressure applied). It uses from one-third to one-half the water used by other motors to grind a pound of coffee with other mills. The water pipes enter at the bottom, and the motive power is in the base, and is transmitted to the grinding parts by means of a vertical shaft and machine-cut gears. It is a handsome affair, and is worthy of a position in the finest grocery in the world.

It costs $7 a year for water to grind 10,000 lbs. (5 tons) at 20 cts. per 1,000 galls. It costs $3.50 a year for water to grind 10,000 lbs. at 10 cts. per 1,000 gals. (with 60 lbs. pressure). With a higher pressure a smaller quantity of water would be required. Taking water at highest rates the cost is a song. What better advertisement could be had? The "CYCLONE" Mill will grind coffee with any pressure from 25 lbs. up. The "CYCLONE" Mill is a complete machine, no belting or pulleys required. It occupies less room than other coffee mills, and is superior to any mill made. Is elegantly painted, and takes everybody by storm. Costs less money than motors and mills with belts and pulleys. Is always ready, never out of repair. Easily adjusted to grind coarse or fine. "CYCLONE" Mills are made to be run by water or electricity.

Our electric motor "CYCLONES" are furnished with resistance box free, all ready for connection with street wires of 110 and 220 voltage or any voltage desired below 110.

Patented.



Six feet high.

THE

Belknap Water Motor Co.

Manufacture seven sizes of Water Motors, from No. 4, with a 4-inch wheel, up to a 24-inch. They also manufacture Dynamos and Electric Motors, Motors and Dynamos combined, Coffee Mills which are a combination of motor and mill in one case (see accompanying cut of "Cyclone" Mill). These motors represent a greater power than any motors that have ever been placed upon the market, the No. 16 representing equal power with other motors of 45 inches diameter, which is about as large as motors are ever made. A No. 20 would be equal to a 60-inch, and a 24 to a 72 inch, if such were in existence. These motors produce from the water applied a greater percentage of power than has ever been attained by any motor yet invented.

Patented.

The Little Giant Water Motor,

IMPROVED.

(PATENT APPLIED FOR.)

The BELKNAP LITTLE GIANT WATER MOTOR, Improved, runs

Gristmills, Elevators,
Saws, Planers,
Machine Shops,
Printing Offices,
Blowers, Fans,
Air and Water Pumps,
Hoisting Machinery,
Electric Lights,
Ice Cream Freezers,
Bottle Washers,
Coffee and Spice Mills,
Church Organs,
Lathes, Scroll Saws,
Sausage Machines,
Feed Cutters,
Dentists' and Druggists' Machines,
etc., etc.

Before going to enormous expense putting in steam, write for particulars about the Little Giant Water Motor, Improved, as it is now manufactured by the

BELKNAP WATER MOTOR COMPANY,

GEO. W. BROWN,

General Manager,

22 Exchange Street,

PORTLAND, ME.

NAME WHERE YOU SAW THIS.

Secretaries.

Monk, W., Hamilton, Ont. 668
Moodie, R. B., Franklin, O. 370
Moore, M. M., 111 Liberty St., N. Y. City. 317
Moore, R. W., Parker's City, Pa. 257
Morehead, S., Minerva, O. 376
Morgan, A. A., Moravia, N. Y. 160
Morris, M. A., Indianapolis, Ind. 392
Morris, E. H., Warsaw, N. Y. 188
Morrison, Ellis, N. Y. City. 229
Morrison, W. G., Willimantic, Conn. 125
Morsalis, T. L., E. Dallis, Tex. 576
Morse, Frank G., Holbrook, Mass. 57
Morse, W. B., St. Clair, Mich. 427
Mortimer, R. D. S., Marlborough, Mass. 67
Mott, S. H., Los Angeles, Cal. 622
Mould, H. M., Keeseville, N. Y. 155
Moxuam, A. J., Johnstown, N. Y. 242
Moyer, Geo. S., Philadelphia, Pa. 271
Muirkheid, Jno, J., Pennington, N. J. 211
Mulhall, Jno., 89 State St., Boston, Mass. 330
Mullins, R. F., 10 Wall St., N. Y. City. 142
Murray, P. W. Saint Ignace, Mich. 427
Muse, A. D., Jackson, Tenn. 346
Myers, H. H., Brinkley, Ark. 567
Myers, J. K., Sea Cliff, N. Y. 181
Nadeau, J. A., Iberville, P. Q. 658
Nash, Henry H., Weymouth, Mass. 92
Nault, Jos., St. Hyacinthe, P. Q. 662
Neal, Wm., Helena, Ark. 570
Neville, A. C., Green Bay, Wis. 464
Neville, Thos. J., Rochester, N. Y. 177
Newell, Herbert, Shelburne Falls, Mass. 81
Newman, Geo. A., Cedar Falls, Ia. 478
Newman, L. M., Chippewa Falls, Wis. 463
Newton, H. M., E. Saginaw, Mich. 410
Newton, Moses, Holyoke, Mass. 58
Newton, S. H. M., East Saginaw, Mich. 411
Nichols, F. B., St. Louis, Mo. 578
Nichols, Jno., Georgetown, Ky. 353
Niemeyer, H. C., Wheatland, Cal. 641
Noble, C. H., New Milford, Conn. 117
Nock, Jno. A., San Luis Obispo, Cal. 635
Norcross, F. C., Lorain, O. 374
Norkett, W. G., So. Evanston, Ill. 457
Norris, Wm., San Francisco, Cal. 634
Norton, S. B., Granville, N. Y. 147
Norton, W. G., Lockport, Ill. 448
Norwood, E., Navasota, Tex. 580
Nutt, N. B., Eastport, Me. 7
Olmstead, Theo. F., Geneseo, N. Y. 145
Omstead, W. P., Lockport, N. Y. 158
Olney, H. H., Stockton, Kan. 523
Osten, Frank F., Colton, Cal. 617
Pack, H. E., West Colfax, Colo. 600
Page, R. M., Abingdon, Va. 299
Painter, J. L., Bellevue, O. 362
Painter, M. D., Pasadena, Cal. 627
Palmer, B., Great Barrington, Mass. 55
Palmer, C. J., Little Falls, N. Y. 158
Palmer, F. L., Pomona, Cal. 628
Park, W. S., Beloit, Kas. 506
Park, W. J., Larned, Kan. 593
Parker, E. F., DePere, Wis. 463
Parmley, Henry M., Mahanoy City, Pa. 348
Parry, Howard, Riverton, N. J. 213
Patterson, F. G., Lookout, Colo. 660
Payson, E. R., Portland, Me. 3, 11
Peck, E. H., Coolidge, Kans. 509
Pearson, W. K., Anamosa, Ia. 477
Perrin, Geo. E., Batavia, N. Y. 131
Perry, Jr., Chas., Westerly, R. I. 104
Pettenhouse, W. S., Hackettstown, N. J. 202
Pettigrew, T. M., Sundance, Wyo. 550
Pettit, A. H., Sauk Centre, Minn. 502
Phillips, H. C., Woodstock, Vt. 34
Phillips, R. O., Lincoln, Neb. 531
Phillips, Sidney A., So. Framingham, Mass. 82
Phillips, W. H., West Bay City, Mich. 430
Phinney, Frank F., Stoughton, Mass. 85
Pierce, A. E., Westfield, N. Y. 191
Pierce, F. H., Las Vegas, N. M. 601
Pierson, Edw., Morristown, N. J. 207
Pierson, F. R., Tarrytown, N. Y. 184
Pitman, Lycurgus, North Conway, N. H. 23
Polhomius, F. M., Texarkana, Ark. 570
Polk, Geo. W., Del Rio, Tex. 575
Polk, M. D., Plattsmouth, Neb. 535
Pollard, Wm. D., Pottsville, Pa. 267
Porch, Jas., Chebanse, Ill. 436
Porlier, Chas. F., Sainte Cunegonde, P. Q. 662
Porter, Hugh, Tombstone, Ariz. 643
Porter, R. L., Salinas, Cal. 632
Potts, Jas., Johnstown, Pa. 242
Powers, H. D., Brainerd, Minn. 496
Pratt, A. J., Coldwater, Mich. 430
Priddy, C. N., Leadville, Colo. 596
Prince, G. C., Oberlin, O. 378
Prince, Geo. T., Atlantic City, N. J. 196
Prinson, D. K., Americus, Ga. 321
Proctor, T. A., Santa Rosa, Cal. 636
Purdy, J. H., Muncie, Ind. 396
Quarton, W. B., Algora, Ia. 494
Quick, C. J., Bluffton, Ind. 388
Quinn, Ed. Gale, Pensacola, Fla. 330
Race, C. H., Burlington, Kan. 507
Raeder, F. W., St. Louis, Mo. 435
Ramsey, Chas. E., Carlisle, Pa. 226
Randall, Jno., Mio, Mich. 421
Raymond, H. S., Galena, Ill. 443
Reagan, G. L., Berwick, Pa. 221
Reardon, Wm., Midland, Mich. 421
Redington, R. J., Troy, Pa. 279
Reid, C., Windsor, Ont. 679
Reid, Chas. A., Trenton, N. J. 215
Reid, Ward, Greenville, Ill. 444
Reinecke, Wm., Louisville, Ky. 357, 440, 461, 464
Rentz, Frank, Ashland, Pa. 219
Repp, Jno. S., Union Bridge, Md. 296
Rhodes, Benj., Niagara Falls, N. Y. 168
Rhodes, D. H., Kingman, Kan. 514
Rice, Richard, Beaver, Pa. 220
Richards, A. B., New York City. 104
Richards, Jos. L., Downington, Pa. 230
Richardson, F. S., North Adams, Mass. 73
Richardson, J. H., Niles, Mich. 423
Ricks, H. L., Eureka, Cal. 619
Ridpath, I. W., Jenkinton, Pa. 241
Rieke, L. M., Paducah, Ky. 358
Riggs, N. A., Evansville, Ind. 390
Ringle, Jno., Warsaw, Wis. 475
Risdon, H. C., Mt. Holly, N. J. 208
Ritter, Wm., Mansfield, O. 374
Roads, J. O., Shenandoah, Pa. 273
Robb, N. W., Reno, Nev. 645
Robbins, Sam'l K., Moorestown, N. J. 207
Roberts, E. J., Colville, Wash. 608
Robertson, Geo. Y., Owego, N. Y. 171
Robinson, Henry, Mercer, Pa. 250
Robinson, J. F., Eugene City, Ore. 610
Roddey, Jno. T., Anderson, S. C. 319
Roe, B. I., Sherman, Tex. 583
Rogent, J. K., Jackson, Mich. 418
Rogers, J. C., Appleton, Wis. 461
Rogers, O. L., Covington, Va. 301
Root, A. K., Lyons, Mich. 420
Rose, Jno. W., Litchfield, Ill. 448
Ross, F. C., Tunkhannock, Pa. 279
Ross, G. M., Elizabeth, N. J. 201
Ross, W. H., Clarion, Pa. 227
Rowley, H. W., Billings, Mont. 551
Ruggles, E. R., Hanover, N. H. 19
Runkle, Wm, 160 Broadway, N. Y. City. 360
Rupert, L. M., Marion, Ia. 487
Sackett, Orange, Avon, N. Y. 130
St. John, A. P., Mobile, Ala. 337
Salmon, C. B., Beloit, Wis. 462
Santee, T. M., Hazleton, Pa. 239
Savage, Chas. P., Dunmore, Pa. 231
Sawyer, H. H., Ridley Park, Pa. 269
Sawyer, Wm. H., Pen Argyl, Pa. 258
Saxon, G. W., Tallahassee, Fla. 332
Scarritt, W. E., Watertown, So. Dak. 544
Schenck, A., St. Louis, Mo. 556, 561, 566
Schilcher, F., Freeland, Pa. 236
Scott, C. K., Wellsburgh, W. Va. 313
Scott, John, Auburn, Cal. 615
Scott, L. L., Naugatuck, Conn. 114
Seager, G. E., Randolph, N. Y. 176
Sechler, H. S., Norristown, Pa. 255
Secor, F. P., Silverton, Col. 599
Sedgeley, J. L., Cloverdale, Cal. 617
Segur, D., Toledo, O. 383
Senn, J. D., West Cleveland, O. 385
Seward, E. B., Santa Fé, N. M. 602
Shallcrass, A. C., Holmesburgh, Pa. 240
Shannahan, Wm. E., Easton, Md. 294
Sharpe, C. A., Lake & La Salle Sts., Chicago, Ill. 390, 461
Shaw, Geo. E., Putnam, Conn. 119
Shay, Wm. F., Watsontown, Pa. 282
Shenston, T. M., Brantford, Ont. 665
Shepard, Jr., F. M., Orange, N. J. 201
Sherwood, A. J., Coquille, Ore. 610
Sherwood, S. M., Sing Sing, N. Y. 182
Shields, Geo. A., Pueblo, Colo. 598
Shippen, Wm., Hoboken, N. J. 203

GET THE BEST.

THE E. STEBBINS MANUFACTURING CO.,

BRIGHTWOOD P. O., SPRINGFIELD, MASS.,

MANUFACTURERS OF

BRASS GOODS,

ROUGH STOPS AND *CORPORATION COCKS.*

Particular Attention Paid to First-Class Ground Key Works for Water-Works.

ALL WORK GUARANTEED.

WATER.

SEND FOR ILLUSTRATED CATALOGUE OF

WELL MAKING MACHINERY.

GAS.

Austin Portable Rock Machine.
For wells from 100 to 1,000 ft.

Hydraulic Jetting Machine.
For wells from 100 to 800 ft.

We are the Largest Manufacturers of the LATEST IMPROVED

WELL-DRILLING AND PROSPECTING MACHINERY,

For Boring for Water, Coal, Oil or Gas in the World.

And Have Facilities for Filling Orders Promptly.

OIL. **F. C. AUSTIN MFG. CO.,** COAL.

Carpenter St. and Carroll Ave., Chicago, Ill.

Secretaries.

Shurtleff, Jno T., Bennington, Vt.. 28
Shuttleworth, L. J., Springville, N. Y..... 182
Sidebottom, L. D., White Cloud, Mich..... . 430
Silliman, J. B., La Porte, Ind..... 394
Simmons, C. E., Oak Park, Ill..... 451
Simmons, J. S., Marysville, Kan..... 519
Simms, J. Standly, Haddonfield, N. J..... 202
Simpkins, D. N., Youngstown, O..... 385
Simpson, Chas. P, Sorrento, Me 14
Simpson, Lawrence, Memphis, Tenn..... 348
Sinclair, Geo. M., Mt. Vernon, Wash..... 608
Singley, L. N., Waynesburgh, Pa. 283
Sipe, Geo. L., New Carlisle, Ind..... 396
Siple, W. H., Hummelstown, Pa 240
Sipp, Geo. H., Holland, Mich..... 416
Slater, E. A., Rich Hill, Mo..... 561
Slauson, Jas., Azusa, Cal..... 616
Slaymaker, S. E., Sunbury, Pa..... 276
Sledge, C. L., Kyle, Tex 579
Sloan, B. F., Erie, Pa..... 234
Sloan, J. R., Covington, Tenn..... 350
Small, Sumner, Northborough, Mass..... 74
Smiley, J. C., Piqua, O..... 379
Smith, Chas. B., Belton, Tex..... 372
Smith, Chas. H., No. Tarrytown, N. Y..... 168
Smith, C. M., Williamstown, Mass..... 94
Smith, E. C., Pipe Stone, Minn..... 500
Smith, F., Kingston, Ont..... 668
Smith, Francis, Winnemucca, Nev 646
Smith, Fred. M., So. Hadley Falls, Mass 82
Smith, G. P., Bay City, Mich 362
Smith, Geo. P., Tonawanda, N. Y..... 185
Smith, H. B., Valparaiso, Ind..... 400
Smith, H. D., Norway, Me 9
Smith, S. J., Carson City, Mich..... 407
Smith, S. S., Mauch Chunk, Pa..... 248
Smith, T. E., Anniston, Ala..... 333
Smith, W. R., Springfield, O..... 382
Snow, Geo. M., Ketchum, Ida..... 649
Snow, W. G., Shreveport, La..... 343
Snow, W. G., Steven's Point, Wis..... 474
Snow, W. G., Vicksburg, Miss..... 341
Snowden, F. T., Catonsville, Md..... 292
Soule, E. E., Dodge City, Kans..... 510
Southern, H. K., N. Y. City 281
Speakman, Isaac, Coatesville, Pa..... 228
Spencer, H. S., Hamburgh, N. Y..... 149
Speyer, D., Paso Robles, Cal..... 627
Spillings, D. N., Winchester, Mass..... 19
Spinner, Chas. C., Herkimer, N. Y..... 151
Sprigg, W. O., Frostburgh, Md..... 294
Squire, E., Defiance, O..... 368
Squires, G. C., Duluth, Minn..... 497
Stake, Edw., Hagerstown, Md 295
Stall, I. G., Union City, Ind. 400
Starr, H. C., Akron, O..... 360
Statesman, J. F. Belleville, Kan..... 506
Staytor, Jos., Newport, Ark..... 569
Steel, W. C., Etna, Pa..... 235
Stetson, W. W., San Francisco, Cal..... 646
Stevens, A. A., Taylor, Tex..... 583
Stevens, A. A., Tyrone, Pa..... 280
Stevens, Geo. D., Crete, Neb 529
Stevenson, Wm., Sayre, Pa..... 270
Steward, G. H., Vancouver, Wash..... 607
Stewart, Jas., Oneonta, N. Y..... 170
Stewart, W. W., Tremont, Pa..... 279
Stickney, E. N., Swampscott, Mass..... 86
Stiger, W. E., Council Grove, Kan..... 510
Stilson, Geo., Franklin, N. Y..... 144
Stone, H., Fort Smith, Ark..... 567
Stone, W. B., Galena, Kan..... 513
Stoss, Jr., Louis, 310 Sansome St., San Francisco, Cal..... 629
Stoughton, C. R., Riverside, Mass..... 79
Stickler, J. N., Topeka, Kan..... 511
Stroup, C. B., Elizabethville, Pa..... 286
Steben, B. F., Brockville, Ont..... 665
Sturges, Henry, Springer, N. M..... 602
Surls, Kate G., E. Liverpool, O..... 369
Surtees, Robt., Ottawa, Ont..... 672
Sutter, D. W., Lake Linden, Mich..... 418
Sweet, Van R., Phœnix, N. Y..... 173
Sylvanus, T. R., Galesburg, Ill..... 444
Taft, C. A., Uxbridge, Mass..... 87
Tarleton, A., Columbia, Cal..... 618
Taylor, Henry, Scottdale, Pa..... 286
Terry, Jr., G. W., Atlanta, Ga..... 322
Thayer, C. T. Ewing, Cherry Vale, Kans.. . 508
Theobald, Chas. E., Biloxi, Miss..... 340
Thomas, C. O., Caro, Mich 407
Thomas, J. R., Escondido, Cal..... 618
Thomas, J. W., Lansing, Ia..... 485
Thomas, M. W., Chestertown, Md 293
Thomas, W. J., Georgetown, Tex..... 577
Thompson, N. J., Pine Bluff, Ark..... 569
Thompton, Fred., Neligh, Neb..... 533
Thresher, M. S., Stockton, Cal..... 637
Tingley, C. E., 105 Sumner St., Boston, Mass.. 62
Torrance, David, Birmingham, Conn 107
Towner, A. J., Avoca, N. Y..... 130
Traenmer, Geo. P., Milwaukee, Wis..... 470
Trainer, J., Charleston, Ill..... 436
Treadway, C. S., Bristol, Conn..... 109
Treman, E. M., Ithaca, N. Y..... 151
Trotter, J. A., Columbus, Ind..... 389
Trotter, J. G., Marshalltown, Ia..... 487
Turner, Wm., Rouse's Point, N. Y..... 178
Tuttle, R. B., Fredonia, Kan..... 513
Tywell, A. C., Madison, Neb..... 532
Ulrich, J., San Antonio, Tex..... 582
Underwood, W. A., Alton, Ill..... 432
Valentine, D. A., Clay Centre, Kan..... 508
Van Arsdale, A. B., Yuba City, Cal..... 641
Vanatta, J. K., Colorado City, Col..... 589
Vanderpool, Eugene, Newark, N. J 215
Van Hoven, Fred., Pontiac, Mich..... 425
Vicks, T. S., La Crosse, Wis..... 468
Voorhis, A. M., Nyack, N. Y..... 169
Waddingham, W. J , Ontario, Cal..... 626
Wait, H. O., Salamanca, N. Y 179
Wait, Robt. J., Greenwich, N. Y..... 149
Walker, Edwin B., Saugerties, N. Y..... 180
Walker, R. H., Gonzales, Tex..... 578
Wall, W., Murphysborough, Ill..... 451
Ward, H. C., Sterling, Ill..... 457
Wardwell, M. H., Bangor, Me..... 15
Warner, O. C., Georgetown, Col..... 593
Waterhouse, E. F., Sherbrooke, P. Q..... 662
Waters, L. A , Scranton, Pa.....243, 252, 253
Watson, F. W., Eureka, Kans..... 511
Watson, H. C., Richfield Spgs, N. Y..... 176
Weads, Lester C , Malone, N. Y..... 159
Weems, R. N., Kansas City, Mo..... 559
Wells, N. A., Mesheppen, Pa..... 250
Wentworth, Jas., Lexington, Mo..... 560
Wentworth, T. D., Rochester, N. H..... 25
West, Geo. F., Portland, Me..... 5, 565
Westcot, H. C., Ballston Spa, N. Y..... 131
Westcott, Frank, Seneca Falls, N. Y..... 181
Wharton, J. R., Butte City, Mont..... 552
Wheat, Newton J., Attleborough, Mass..... 37
Wheatley, J. A., Audobon, Ia 477
White, C. A., Manchester, Va..... 305
White H. D., Waco, Tex..... 585
White, J. D., Florence, Ala..... 335
White, O. A., Norwalk, O..... 378
White, R. M., Abilene, Kan..... 504
White, W. S., Rockland, Me..... 12
Whiteman, Horace, 233 South Fourth st., Philadelphia, Pa..... 247
Whiton, Starkes, Hingham, Mass..... 57
Wickham, T. A., Tioga, Pa..... 278
Wicker, D. L., Austin, Tex 571
Wicks, W. B., Sharon, Mass..... 81
Widendorner, Geo., St. Mary's, Pa..... 269
Wiggin, G. W., Franklin, Mass..... 54
Wilber, Cortland, Sherburne, N. Y..... 181
Wilde, A. J., Johnstown, N. Y..... 155
Wilder, E., Topeka, Kan..... 624
Wiley, K. N., Adrian, Mich..... 403
Wiley, S. M., Grand Haven, Mich..... 413
Wilke, Douglas, Cartersville, Ga..... 324
Wilken, W. A., Atlantic, Ia..... 477
Wilkinson, H. P., Wheeling, W. Va..... 314
Willard, S. J., Red Wing, Minn..... 500
Willard, U. H , Nunda, N. Y 169
Williams, G. W., Newark, Del..... 287
Williams, L. H., New Castle, Pa..... 255
Williams, Smyser, York, Pa 285
Williamson, T. S., Danville, Va..... 301
Willman, Alex., Hailey, Ida..... 648
Wilson, G. R , Elgin, Ill..... 441
Wilson, G. W., Vallejo, Cal..... 639
Wilson, H. G., Bellaire, O..... 361
Wilson, J. A., Cannon Falls, Minn..... 496
Winsor, L. B., Reed City, Mich..... 426
Wirt, R. M., Hanover, Pa..... 238
Wold, Jno., Austin, Minn..... 495
Wood, Horatio D., Hannibal, Mo..... 556
Wood, Jno. H., Baton Rogue, La..... 342
Wood, Walter, Philadelphia, Pa..... 273, 391, 571
Woodman, H. H., Bethel, Conn 106
Woodruff, Timothy, Bridgeton, N. J..... 197
Woodruff, W. T., Thomaston, Conn..... 122
Woodward, F. S., No. Yakima, Wash..... 604

JOHN F. MOFFETT.
JOHN V. CLARKE, C. E.

HENRY C. HODGKINS, C. E.
CHARLES T. MOFFETT.

Moffett, Hodgkins & Clarke,

CONTRACTING ENGINEERS,

Syracuse, N. Y.

WATER-WORKS.

Within the past eight years have made maps, plans and estimates for Water-Works and sewerage in over two hundred Cities and Villages in the United States and Canada.

Have constructed and now own and operate water works in the following places, viz.

West Troy, N. Y.	Spartanburg, S. C.	Manitowoc, Wis.
Watertown, N. Y.	Canandaigua, N. Y.	Portage, Wis.
Adams, N. Y.	Waterford, N. Y.	Baraboo, Wis.
Fulton, N. Y.	White Plains, N. Y.	Escanaba, Mich.
Oswego Falls, N. Y.	Newark, O.	Kankakee, Ill.
Homer, N. Y.	Chippewa Falls, Wis.	Lincoln, Ill.
Cortland, N. Y.	Menomonee, Wis.	Cornwall, Ont.
Green Island, N. Y.	Belleville, Ont.	Rochester, Minn.
Greenbush, N. Y.	Beaver Dam, Wis.	Duluth, Minn.
Newark, N. Y.	Berlin, Ont.	Washington, Ind.
Delaware, O.	Salisbury, N. C.	Jackson, Miss.
Marshall, Mich.	Kingston, Ont.	Cobourg, Ont.
Waterloo, Ont.	Canton, N. Y.	

Have Water-Works now in process of construction at the following places, viz.:

Peoria, Ill.	La Grange, Ill.	Kincardine, Ont.
	Ingersoll, Ont.	

The construction of Water-Works, Gas Works and Sewerage for Cities and Towns a specialty. Plans, specifications and estimates prepared by careful engineers and receive the benefit of our wide experience. Also general railroad and electrical engineering and construction. Information concerning any proposed work respectfully solicited.

Address,

MOFFETT, HODGKINS & CLARKE,

SYRACUSE, N. Y.

New York Office:
No. 34½ PINE STREET.

Chicago Office:
No. 720 OPERA HOUSE BLOCK.

Secretaries.

Woolworth, Eugene B., Clinton, N. Y.... 137
Work, G. F., Macon, Ga.... 326
Young, E. B., Eufaula, Ala.... 331
Young, F. C., Silver Cliff, Colo.... 598
Zearing, I. N., Bellefontaine, O.... 361
Zeitler, Chas., Havre de Grace, Md.... 295
Zimmerman, Davis, Charleston, S. C.... 320
Zimmerman, H., Annville, Pa.... 285
Zimmerman, H., Marine City, Mich.... 420
Zorns, J. E., Doylestown, Pa.... 230

ENGINEERS.

[Includes Designing, Contracting and Consulting Engineers.

Abbott, E. A.... 406
Abbott, E. L.... 399
Abbott, Jno., Portland, Ore.... 605
Aber, D. J.... 518
Adams, Julius W., New York City, N. Y...115, 132
Aldersby, Ed., Anderson, Cal.... 615
Alexander, E. S., Chicago, Ill.... 443
Alexander, Geo., Boston, Mass.... ...13, 42, 55
Allan, Donald, Staunton, Va.... 309
Allardt, G. F.... 623
Allen, C. P., Denver, Col.... 591, 593
Allen, Jas., Lynchburg, Va.... 302, 309
Allen, Jas. W.... 197
Allen, Kenneth, Kansas City, Mo.... 514, 518
Allen, W. E.... ....161, 309
Alves, Gaston M.... 354
Alvord, J. W., Ashland Block, Chicago, Ill.... 439
Ambrose, Wm.... 615
Amer. Pipe Mfg. Co., Germantown Junction, Pa.... 213
Anderson, L., Cincinnatl, O.... 316
Anderton, Geo , Talladega, Ala.... 338
Andrews, Jas. A., Hudson, Wis.... 465
Andrews, J. W., Winston, N. C.... 318
Andrew, L. P., St. Louis, Mo.... 556, 565
Anthony, Geo. W., Eureka, Ill.... 442
Arbuckle, F. P., Denver, Col.... 591, 595, 600
Archer, Jas.... 590
Archibald, A. L.... 655
Arms, W. F., Punxsutawney, Pa.... 217
Armstrong, A., St. Paul, Minn.... 502
Armstrong, A. H.... 625
Arnold, B. C.... 616
Arnold, D. M.... 184
Augur, E. P 109
Avery, Wm. H.... 425
Ayers, H. W.... 109
Ayres, Jr., Sylvanus, Bound Brook, N. J.... 198
Babcock, Stephen E., Little Falls, N.Y. 128, 149, 154, 157, 191.
Baerman, P. H., Troy, N. Y....139, 154, 156, 168, 176, 191.
Bailey, Geo. H., Newark, N J.... 117, 208, 213, 651
Baillarge, C., Quebec, P. Q.... 660, 661
Baldwin, Geo. B.... 661
*Baldwin, Geo. R.... 660
Ball, Phineas, Worcester, Mass .. 20, 36, 42, 43, 52, 53, 62, 65, 76, 79, 83, 90, 93, 94, 115.
Ballou, C. A., Danville, Va.... 301, 909
Barbour, Jos. E.... 602
Barbour, Wm. S.... 47
Barclay, Frank, Beatrice, Kan.... 525, 526
Bardwell, N. H 20
Barnes, R. D.... 109
Barrett, Jno., Portland, Ore.... 610
Barrett, Wm. S.... 110
Barstow, C. D.... 250
Bartley & Co , W. P., Montreal, P. Q.... 659
Barton, H. B., Centreville, R. I.... 101, 102, 105
Bartram, I. N., Sharon, Conn.... 119
Bassett Bros., Buffalo, N. Y., 128, 131, 137, 147, 172, 173, 194.
Bassett Carrol Ph., Newark, N. J 215
Bassett, J. M., Weatherford, Tex.... 573
Bassett, M. E.... 278
Bates, Moses.... 76
Battin, L. B.... 201
Baum, J. W., Atalanta, Ga.... 325
Baxter, F. K., Utica, N. Y.... 150
Baxter, G. R., Utica, N. Y.... 136
Baxtor, K. F., Utica, N. Y.... 136
Beach, G. E., Minneapolis, Minn., 405, 466, 481, 492, 495, 497, 500, 502, 541, 543, 551.
*Beall, Nelson.... 294
Beardall, Wm., Sanford, Fla.... 330
Beauchemin & Sons, Sorel, Que.... 663
Beaudry, J. A 661
Beique, J. B.... 657
Belcher, J. E.... 673
Bell, G. B., Covington, Va 301
Bell, Jas.... 417
Bell, Jas. A., St. Thomas, Ont.... 670, 673, 676
Bell, L. S.... 295
Bement, R. B. C 496, 499
Bement & Co., R., St. Paul, Minn.... 499, 551
Benford, G. L.... 250
Bennett, A. W.... 87
Bennett, C. M., Richmond, Ind.... 369
Bennett, Wm., Jackson, Mich.... 417
Benzenberg, Geo. H., Milwaukee, Wis 470
Bettes, Stockwell, Springfield, Mass.... 48
Betts, A. L.... ....144, 152, 155, 168, 180
Betts, B. F., Tonawanda, N. Y.... 185
Bevan, Sam'l, Tacony, Pa.... 276
Bigerman, Henry 145
Bigony, A. J 246
Bird, Henry D., Petersburgh, Va.... 306
Birdsall, F., Sacramento, Cal.... 615
Birdsall, Geo. W 164, 167
Birkinbine, Harry.... 480
Birkinbine, H. P. M.,* 200, 201, 205, 218, 223, 226, 234, 235, 238, 245, 253, 256, 399. 433, 481.
Birkinbine, Jno.... 256
Bishop, Geo. H., Middletown, Conn...51, 65, 86, 113
Blackie, B. L., Nashville, Tenn.... 348
Blaisdell, Hiram W., Concord, Mass.... 49
Blake Mfg. Co., Geo. F., N. Y. City, N. Y.... 30
Blake, C. H. M.... 98
Blake, Jno. H., Jersey City, N. J.... 44
Blake, Percy M., Hyde Park, Mass. 12, 17, 36, 38, 51, 66, 68, 73, 74, 80, 86, 87.
Bliss, H. I.... 467
Boardman, A. E., Macon, Ga...324, 325, 329, 331, 335 339
Boardman, W. F.... 621, 625
Boech, Chas., Atlanta, Ga.... ....335, 338
Bogue, B. G.... 540
Bolton, Ed. D., Asheville, N. C 314
Bolyer, T. O., Kingston, Ont.... 668
Bond, Jas. A.... 289
Bond, Richard, Fortress Monroe, Va.... 301
Bonnett, Wm. W., Waterbury, Conn.... 73
Bonny, A. S.... 213
Booth, C., Kingston, Ont.... 674
Boothby, W. F.... 613
Bott, Anthony 589
Bouscaren, Geo , Cincinnati, O.... 352
Boutelle, T. N.... ....477, 483, 488, 556
Bowditch, E. W., Boston, Mass.... 69, 300, 314
Bowne, Jno. D., Jamesburg, N. J.... 209
Boyce, W. C., Worcester, Mass.... 59
Boyd, J. Edward.... 649
Brainard, E. D., Gt. Barrington, Mass.... 55
Brandon, Geo 159
Branley, Jne.... 239
Breckenridge, C. S 390
Brigden, W. W., Battle Creek, Mich.... 404
Briggs, Geo.... 417
Briggs, Geo. A.... 52, 70, 71
Briggs, G. R.... 445
Briggs, J. G., Terre Haute, Ind.... 452
Briggs, R. E.... 550
Briggs, V. B.... 443
Brinsmade, D. S.... 119
Brough, R. M 678
Brown, Arthur, West Oakland, Cal.... 626
Brown, E. L., Brockton, Mass.... 43
Brown, F. E.... 630
Brown, Jas. H 265
Brown, John H., Bristol, N. H.... 16
Brown, M. T.... 583
Brown, S. O.... 630
Brown, W. C.... 455
Brown, Wm. Providence, R. I 524
Brown, Jr., Wm. M.... 104
Brown, W. W.... 673

Superintendents of Water Works

WILL find us prepared to furnish promptly and at satisfactory prices, all the materials, tools and supplies required for Construction or Repairs.

Correspondence Solicited.

KING & GODDARD,

Dealers in

Pipe, Fittings, Pumps, Hose,

29 PEARL ST., BOSTON.

PIPE

CAST IRON { Plain. Tarred.

WROUGHT IRON { Plain, Cement-Lined, Enameled, Galvanized, Rustless, Tarred.

WOOD { Square, Round, Plain, Coated.

BRASS PIPE AND TUBING.

FITTINGS

— FOR —

ALL KINDS OF PIPE—Special or Regular.

Hydrants,

Service & Valve Boxes,

Corporation Cocks,

Diaphragm Pumps,

Suction Hose,

Tapping Machines.

KING & GODDARD,

29 PEARL ST., BOSTON.

M. J. DRUMMOND,

Cast Iron Gas and Water Pipe.

Flange Pipe
Retorts
Lamp Posts

Stop Valves
Fire Hydrants
Special Castings

2 to 48 in. diameter.

Sole Sales Agent for

Builders' Iron Foundry "Globe" Special Castings.

Office: Corbin Building, 192 Broadway,

NEW YORK.

TROY PUBLIC WORKS COMPANY
LIMITED

FORMERLY SHERMAN & Mc DONOUGH, WEST TROY.

CONTRACTORS FOR
WATER WORKS, VIADUCTS, SEWERS, PAVEMENTS, ETC.
TROY, N.Y.

R. W. SHERMAN, PRESIDENT.

M. McDONOUGH, VICE PRESIDENT.

Engineers.
Brundige, Wm. H., Florence, Ala..... 335
Brunson, Ira P..... 472
Brush, Chas. B..... 203
Bubottom, E. J..... 619
Buch, G. E..... 456
Buehner, Philip..... 604
Buckman, O. H..... 623
Bullock, Saml. R., N. Y. City..... 343
Burgin, J. F..... 117
Burke, W. C..... 595
Burlingame, E. H., Providence, R. I..... 320
Burnham, Wm. H.....477, 482, 484, 489, 490, 493, 513
Burton, Jno. A..... 207
Buss, Edw. A., Boston, Mass..... 80
Butler, W. P., Aberdeen, N. Dak 539, 548
Buttrick & Wheeler..... 81
Butz, E., Pittsburgh, Pa..... 258
Byrne, A. T..... 155

Cahill, D. T..... 579
Cairns, R. A., N. Y. City..... 293
Caldwell, Chas., N. Y. City.....146, 188
Campbell, W. H., Larchmont, N. Y..... 156
Canfield, R. B., Santa Barbara, Cal..... 635
Carson, J. M., Danville, Ill..... 439
Cartwright, Robt..... 248
Casey, J. F., N. Y. City..... 155
Cassin, Isaac S., Phila., Pa., 153, 195, 197, 199, 200, 205, 206, 214, 216, 219, 222, 227, 228, 229, 233, 239, 249, 257, 264, 266, 269, 282, 283, 287, 293, 372.
Chabot, Anthony..... 625
Chaffer, Geo..... 626
Chamberlain, A.*.....114, 125
Chandler, Geo. H., Kalamazoo, Mich..... 428
Chapin, E., Toledo, O..... 354
Chaplin, Dan'l..... 611
Chapman, W. S..... 610
Chappell, Delos A., Chicago, Ill..... 599
Charles, S. A., Lexington, Ky..... 355
Chase, Mr., Corvallis, Ore..... 610
Chase, E. C., Northampton, Mass..... 58
Chase, John C., Wilmington, N. C..... 318
Chase, K. D..... 496
Chaumette, E. N..... 658
*Chesborough, E. S.....39, 264, 445, 676
Chesbrough, I. C..... 127
Chesbrough, S..... 437
Chipman, Willis, Toronto, Ont.....665, 666, 667
Church, Benj. S..... 164
Clark, C. H..... 648
Clark, John..... 579
Clarke, B. R., Boston, Mass.....9, 380, 466, 519, 553
Clarke, Ben. S., Holbridge, Neb.....531, 594
Clarkson, D. A. Pennington, N. J..... 211
Coats, W. R., Kalamazoo, Mich., 406, 415, 425, 430, 444, 475.
Cochran, A. B., Pottsville, Pa.....253, 272
Coffin, Freeman C., Boston, Mass..... 656
Coffin, John..... 242
Coit, Griffith, San Francisco, Cal..... 617
Colburne, B. B..... 540
Colburne, J. B..... 541
Cole, John A., Chicago, Ill.....439, 446, 476, 553
Cole & Gillett, Norfolk, Va..... 314
Coles & Jellette..... 107
Collingwood, Francis..... 142
Collins, H. B., Murfreesboro, Tenn..... 348
Collins, Noyes S..... 329
Confer, J. M., Plymouth, Ind..... 397
Connor, W. C., Dallas, Tex..... 582
Conover, J..... 573
Converse, M. J..... 575
Cook, E. C..... 135
Cook, Edw. D., Baltimore, Md..... 296
Cook, J. D. Toledo, O., 195, 326, 354, 355, 361, 366, 370, 373, 376, 377, 378, 379, 380, 381, 383, 387, 388, 390, 393, 394, 397, 416, 425, 430, 442, 534, 535, 574, 577.
Cook, T. F..... 287
Cooke, E. C., Tiffin, O.....460, 490
Cooper, F. W..... 667
Cooper, Theo., New York City..... 212
Cooper, W. S..... 637
Corbin, H..... 599
*Corbyn, K. P.....439, 496
Corkish, Jno., Portland, Wash., 603, 605, 606, 609, 614, 648, 649.
Corley, John R..... 580
Cornelius, Geo. O..... 281
Costello, E., Blair, Neb..... 528
Coverdale & Weir..... 371
Covert, H. M..... 632
Cowan, Geo. N., Stamford, N. Y.....149, 151, 192
Cowell, T. E., Muscatine, Ia..... 477, 481, 489, 493
Crafts & Forbes, Boston, Mass....8 11, 650, 651, 654
Crafts, N. Henry, Boston, Mass.....31, 47, 98
Craig, Wm..... 496
*Craven, Alfred W..... 322
*Craven, Henry S., N. Y. City..... 164
Crawford, S. P..... 455
Croasdale, W. J..... 650
Croes, J. J. R., New York City..... 113, 120, 163, 205, 211, 243.
Crook, Ed. D., Baltimore, Md..... 302
Cryderman, J..... 603
Cullen, Robt..... 644
Culver, J..... 646
Culver, J. B..... 640
Culver, Jno. P..... 643
Cummings, E. A..... 7
Cummings, E. B., Portland, Me.....1, 4, 5
Curtis, E. A., Fredonia, N. Y..... 176
Curtis, Jos. H..... 87
Curtis, W. W., St. Paul, Min.....449, 479, 503, 504
Cushing, J. T..... 478
Cutshaw, W. E., Richmond, Va..... 307

Dana, S. A., Nipomo, Cal..... 625
Danforth, F., Gardiner, Me..... 6
*Daniel, Travers.....333, 356, 486
Darling, Edwin, Providence, R. I..... 98
Darrach, Chas. G., Philadelphia, Pa..... 213
Davenport, E. F., Springvale, Me..... 14
Davenport, E. R., Charleston, W. Va.....311, 548
Davidson, A. H.....322, 323
Davis & Worthington, Norton, Kan..... 519
Davis, Chester B., Chicago, Ill., 419, 422, 432, 441, 453, 455, 458, 468, 482, 487, 534.
Davis, E. C.....82, 90
Davis, J. B., Ann Arbor, Mich..... 415
Davis, Jas. L., Manchester, Va..... 305
Davis, Jos. P., Boston, Mass.....39, 63, 164
Davis, Preston..... 636
Day, A. R..... 202
De Kinder, J. J., Philadelphia, Pa..... 244
Delafield, C., New York City, 183, 330, 336, 341, 375, 401.
Dennis, H. G., New Bedford, Mass..... 14
Dennis, J. H., New Bedford, Mass..... 392
Des Granges, J. C..... 432
Dezeng, W. D..... 145
Dillin, W. B..... 487
Disbrow, W. H., Mamaroneck, N. Y..... 156
Dittman, Fred., Williamsport, Pa..... 272
Dittmar, J., Williamsport, Fla..... 329
Dolan, Edw., Troy, N. Y..... 186
Doty, D..... 453
Dougherty, Chas., Ft. Pembina, No. Dak..... 547
Doughty, Thos. N.....115, 209
Douglas, Maj. David B..... 164
Douglas, E. A..... 248
Drake & Orton..... 508, 515
Drinkwater, J. H..... 597
Dunbar, E. L..... 405
Dunham & Paine, Cleveland, O.....125, 378
Dunham, H. F., Cleveland, O.....380, 421, 457, 544
Dunlap, J. C., Los Angeles, Cal..... 626
Dunn, J. M..... 486
du Pont, T. C..... 352
Dupras, Evangeliste..... 674

Earle, W. H., Newton, Colo..... 595
Earnshaw, Henry, Cincinnati, O.....393, 394, 457
Eaton, F. H..... 9
Eaton, Horace L..... 81
Ebert, Elias..... 376
Edeburn & Cooper 272, 385
Edington, Jno., Moncton, N. B..... 650
Edwards, Jas. P..... 418
Elbert, Elias..... 387
Ellerbeck, Thos. W..... 647
Ellett, Chas., University of Va., Va..... 310
Elliott, Mr..... 491
Elliott, C. D., Somerville, Mass..... 36
Ellis, Geo. A., 71 Equitable Bldg., Boston, Mass..... 315, 472
Ellis, Jno. W..... 104
*Ellis, N. W..... 21, 23
Ellis & Co., N. W., Manchester, N. H..... 16, 20
Ellis, R. N., Jacksonville, Fla..... 328
Ellsworth, E. A..... 58
Emack, Jno. D., Slatington, Pa..... 274
Emigh, J. H..... 152
Enright, Jos., San Jose, Cal..... 632
Erdman, Fredk., Alexandria, Va..... 238, 243, 299
Ernst, Maj. O. H..... 191
Escoff, Jas., McKeesport, Pa..... 268
Evans, Geo. E., Boston, Mass..... 63, 553

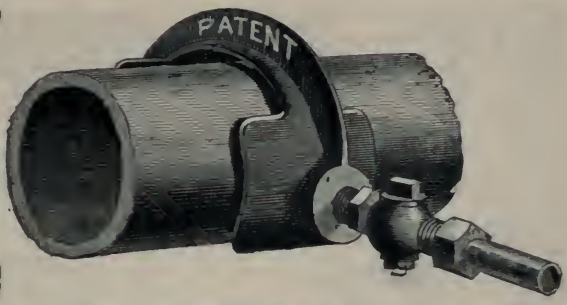
HAWKES'

IMPROVED

BAND

FOR TAPPING

Cement-Lined Pipe



GUARANTEED THE BEST IN USE.

Manufacturers of all Kinds of

CORPORATION

COCKS.

FRED. H. HOLTON & CO.

Copper and Brass Works,

52 PEARL STREET, - - - BOSTON, MASS.

Send for Descriptive Circular and Price-List.

FROST & ADAMS

Importers, Wholesale and Retail Dealers in

ARCHITECTS' AND ENGINEERS' SUPPLIES.

Finest Swiss, German, English, French and American Mathematical Instruments and Drafting Materials.

Best known Brands of Drawing Papers, Tracing Cloths, Tracing Papers, India Inks, Water Colors, T Squares, Triangles, Scales, Rules, Tape Measures, Pencils, Brushes, Round Writing Materials.

United States Agents for Albert Levy's Superior Blue Process Papers and Architectural Photographs.

37 Cornhill, Boston, Mass.

SEND FOR SAMPLES AND PRICES.

SAM'L LITTLE, Pres. WM. J. BRIDE, Treas.

Boston Lead Mfg. Co.,

Cor. Congress & Franklin Sts.,

162 Congress St., 180 & 182 Franklin St.

BOSTON, MASS.

MANUFACTURERS OF

Lead Pipe, Sheet Lead,

Patent Tin Lined Pipe and Pure Block Tin Pipe.

BOSTON STAR BRAND

PURE WHITE LEAD

Red Lead and Litharge.

ALSO DEALERS IN

Pig Lead, Pig Tin, Copper and Iron Pumps, etc.

Engineers.
Evans, Harry, Troy, O. 383
Evans, H. E., York Village, Me. 15
Evans, Jno. 131
Fairbanks, Mr., St. Louis, Mo. 489
Fairbanks, Morse & Co., Chicago, Ill. 376, 433, 442, 489, 510, 545.
Fairbanks, Chas. R 653
Fairgrieve, J. B. E. Hugh, Hamilton, Ont. 666
Fankisley, Wm., Coolidge, Kan. 509
Fanning, John T., Minneapolis, Minn., 21, 31, 116, 117, 124, 501.
Farmington, J. A., Portsmouth, N. H. 25
Farney, Jno. H. 336
Farnum, H. H. 174
Farrington, J. A. 25
Fehr, H. R., Easton, Pa. 245
Feldpauche, A., Philadelphia, Pa. 288
Felton, F. W., Omaha, Neb. 528
Felton, S. K., Omaha, Neb. 489, 506, 534, 536, 537
Felton Co., S. K. 529
Ferris, E. G 462, 479, 486
Ferris, Garwood, Jersey City, N. J. 58
Ferris & Halliday, Jersey City, N. J., 10, 146, 204. 315
Ferry, W. M. 647
Field, Alfred R. 56
Finkle, F. C., San Bernardino, Cal. 632
Finley, Jas 202
Fitzgerald, Desmond, Boston, Mass. 41
Fitzgerald, J. Leland, Schenectady, N. Y. 135
Flanders, J. P 31
Flannery, Jos. 254, 359
Flannigar, T. J. 638
Flint, Walling & Co., Kendallville, Ind. 426
Forbes, A. W., Boston, Mass. 12, 97, 652
Forsberg, A. Lynchburg, Va. 303
Foster, F. L. 679
Foster, Joel. Montpelier, Vt. 27, 29, 33
Fourman, A. 657
Fowler, Chas, E. 172, 184
Fox, J. M. Visalia, Cal. 639
Franklin, W. S. Johnstown, N. Y. 162, 181
Franklyn, W. M. S. 156
Freeman, W. R. San Antonio, Tex., 574, 575 582, 584, 585
Freeman, W. W 580
French, Edwin 162
Frizzell, Wm 588
Fry, P. 625
Fteley, A., N. Y. City 39, 40, 142, 164
Fuertes, E. A., Ithaca, N. Y. 139
Fuller, Allen, J. 263
Fuller, E. F. 11 Wall St. N. Y. City. 227, 326, 343, 364, 391, 392, 400, 421, 575
Fuller, Frank L., 12 Pearl St., Boston, Mass., 61, 88, 89, 95, 96
Fuller, Frank M 67
Fuller, L. F., Calvert, Tex. 572
Fulton, Mr. 285
Galt, Jno., Toronto, Ont. 665, 666
*Gaskill, H. F., Lockport, N. Y. 179, 668
Gatchell, Thos. K., Selma, Ala. 338
Gans, Jos., Wellsburgh, W. Va. 313
Gay, Chas. W., Lynn, Mass. 80
George, Jno. A 385
Gerlich, G., New Braunfels, Tex. 580
Geyelin, Emile 206
Ginn, W. A. 381
Glamorgan Co., Lynchburg, Va. 300
Gleaves, R. Taylor, Lynchburg, Va. 310
Glover, E. F. 461
Godder, S. V., Lake George, Fla. 274
Goldthwaite, W. J., Marblehead, Mass. 67
Goodell, Chas. R., Cumberland Mills, Me. 10
Goodhue & Birnie, Springfield, Mass. 19, 36, 121, 122, 386, 457
Goodhue, C. L., Springfield, Mass. 75, 91, 386
Goodhue, W. T., Milwaukee, Wis. 462
Goodman, David *277
Goodman, Thos. J 394
Goodwin, Joseph 603
Gordon, B. 333
Gould, E. Sherman, Scranton, Pa. 271
Gould, M. A. 449
Gowen, Thos. 606
Gowing, E. H., Boston, Mass. 3, 7, 13
Granger, A. O., Philadelphia, Pa 662
Grant, E. M., Morgantown, W. Va. 312
Grant, Jno. A 322
Graves, E. 195
Gray, Jr., & Co., C. E., Chicago, Ill. 476
Gray Bros., Milwaukee, Wis. 546
Gray, Carroll E., Chicago, Ill 496, 497
Gray, Saml. M., Providence, R. I. 103, 111
Greene, Chas. E., Ann Arbor, Mich 404
Greene, Prof. D. M., Troy, N. Y. 30, 159, 185
Greene, Geo. S., N. Y. City 165, 166, 192
Greene, H. H., Cadillac, Mich. 406, 418
Gregg, D. L., Concordia, Kans. 509
Groscup, Mr. 571
Grote, Aug. W. 561
Grover, Edmund, Iron Gate, Va. 300
Guernsey, A. D., Independence, Ia. 484
Guild & White. 345
Guilford, Simeon 245
Hall, Thos. V 567
Hall, Wm., Sacramento, Cal 616
Hamilton, Jno. 623
Hammatt, E. A., Boston, Mass. 38, 85
Hanck, A. D. 511
Handy, H. P., Ft. Collins, Colo 592
Hare, E. F. 639
Harlow & Co., Jas. H, Pittsburgh, Pa., 234, 283, 284, 448.
Harlow, Geo. R., Pittsburgh, Pa. 135, 390
Harlow, J. C., Pittsburgh, Pa. 376
Harlow, Jas. H., Pittsburgh, Pa., 63, 244, 250, 254, 264, 277, 448.
Harper, L., Omaha, Neb. 550
Harris, Geo. W., Hagerstown, Md. 294
Harris, R. W. 574
Harris, W. B. 82
Harrison, H. H., Stillwater, Minn., 428, 464, 465, 496, 500, 501, 502.
Harrison & Hawley, St. Paul, Minn. 498
Hartly, H. M. 616
Hastings, Jos, Portsmouth, Va. 307
Hastings, L. M. 47
Hathaway, Ellis, Montgomery 327
Hatch & Taylor, McKeesport, Pa. 2
Hawes, L. E., 75 State St., Boston, Mass. 38
Hawley, J. B. 501
Hawley, W. C., Cambridge, N. Y. 134, 441
Hayne, Mr. 582
Heald, S. C., Worcester, Mass 34, 79, 82, 93
Hedeman, H. E., Lampasas, Tex. 579
Heermans, H. C., Corning, N. Y. 283
Helm, Jr., Jno., Port Hope, Ont. 674
Henderson, Smith's Falls, Ont. 675
Henderson, Alex., Fredericksburg, Va. 301
Henderson, Jno. M., Omaha, Neb. 398
Henry, D. C., Boston, Mass. 374, 544
Henshaw, Geo. W., Winston, N. C. 318
Hermany, Chas., Louisville, Ky. 352, 353, 355
Heron, G. C. 573, 577, 583
Hering, Rudolph, New York City 217, 322
Herschel, Clemens, Holyoke, Mass. 39, 94
Hersey, G. D 370
Hess, Alex. W 634
Hess, J. H., Ottawa, Kan. 520
Hewlett, H. N., Oscoda, Mich. 424
Highlands, S. M., Pittsburgh, Pa. 340
Hill, Arthur E., New Westminster, B. C. 684
Hill, Chas. W., Wellington, Kans. 514, 521, 524
Hill, Jno. W., Cincinnati, O. 311, 313, 369, 374, 424
Hinds & Bond, Watertown, N. Y. 665, 671
Hinsdale, Wm. R., Beloit, Wis. 145, 394, 444, 464, 479
Hoar, J. A., Newport, R. I. 96
Hodgkins, Henry C., Syracuse, N. Y. 377
Hogan, Peter, Albany, N. Y., 146, 162, 177, 186, 190, 402, 412, 413.
Holley, Byron, Columbia, S. C 161, 323
Holly, Birdsall, Lockport, N. Y., 352, 393, 411, 417, 418, 455.
Holly Mfg Co., Lockport, N. Y., 154, 158, 179, 183, 229, 293, 374, 389, 390, 393, 420, 426, 442, 461, 511.
Holman, M. L., St. Louis, Mo. 564
Holmes, A. L., Grand Rapids, Mich., 397, 400, 407, 410, 413, 424, 425, 429, 430, 463, 475, 587, 595, 596, 597.
Holmes, C. M., Seguin, Tex. 582
Holmes, Jno. 474
Hopkins, Chas. C., Rome, N. Y. 126, 136
Hopper, Thos. 186
Horne, Sam'l 81
Hornung, Geo., Cincinnati, O. 357, 375, 381
Horton, W. N. 604
Hotchkin, Geo. A., Rochester, N. Y. 145
Hough, U. B. 499
House & Kiersted, Omaha, Neb. 528
Howard, J. S. 611
Howell, Geo. W. 206
Howell, J. M., Chicago, Ill. 360, 370

BOSTON & LOCKPORT BLOCK COMPANY.

FACTORIES AT

BOSTON, MASS. - - LOCKPORT, N. Y.

HAND POWER DIAPHRAGM PUMPS.

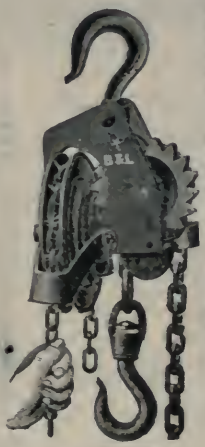
These pumps are particularly adapted to pump out water mixed with sand and gravel (as they are perfectly non-chokable), the suction being accomplished by the rubber diaphragm. The capacity, being 3,500 gallons per hour, makes it a valuable pump in the construction of water-works.

SEND FOR CIRCULAR.

162 Commercial Street, Boston, Mass.

This cut shows a view of our

IMPROVED BATTS DIFFERENTIAL HOIST,



which without exception is the most compact hoist in the market, which is often a great advantage when the hoisting has to be done in a contracted space.

The only hoist in the market where one man only is required to lift the load of any capacity of hoist.

The hand chain will never catch on the guard, which is quite an advantage.

Send us an order for one of these blocks, and if not satisfactory in every way, you can return it.

OFFICE:

162 Commercial St.,

BOSTON, MASS.

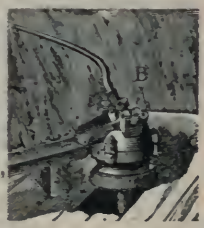
W. & B. DOUGLAS,

MIDDLETOWN, CONN.

BRANCH WAREHOUSES:

85 & 87 John Street, New York.

197 Lake Street, Chicago, Ill.



Manufacturers of over 1,000 Styles Pumps.

Contractors should use the DOUGLAS DIAPHRAGM PUMP (Loud's Patent), especially adapted for Pumping out Ditches, Cellars, etc.

Water-Works Superintendents should examine our Patent Telescopic Curb Boxes, Yard Hydrants, Street Washers, etc., which are now largely used.

SEND FOR DESCRIPTIVE CIRCULAR OF THESE GOODS.

G. E. DOWNING, President. JAMES BOWRON, Vice-President. A. H. MOORE, Secretary.

SOUTH PITTSBURG PIPE WORKS,

South Pittsburg, TENN.

MANUFACTURERS OF

ALSO

Flange Pipe, Specials, Loam Work.

GENERAL FOUNDERS AND MACHINISTS.

Correspondence Solicited and Prices Furnished on Application.

Engineers.

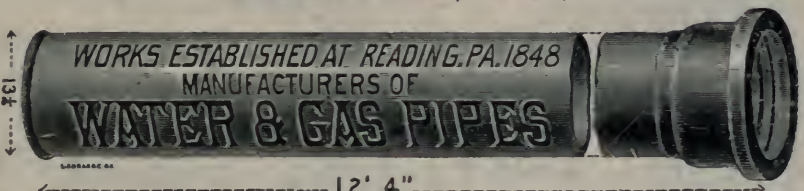
Howland, A. H., 61 Equitable Building, Boston, Mass., 48, 59, 76, 80, 81, 85, 92, 315, 337, 457, 472.
Howland & Ellis, Boston, Mass.,.....334, 374, 544
Hoxsie, Gen. Thos. D 210
Hughes, B. T., Tamaqua, Pa 277
Hughes, Jno.,Chateaugay, N. Y..... 136
Hull, B. H., Bridgeport, Conn..... 117
Hull & Palmer, Bridgeport, Conn..... 107
Humphrey, J. S., Garden City Kans..... 513
Humphrey, John..... 20
Hungerford, W. S., Clifton Forge, Va..... 300
Hunt, Chas. W., New Rochelle, N. Y..... 163
Hurlburt, W. D..... 496
Hutchinson, F. W..... 642
Hutton, Wm. R..... 289
Iler, F. M..... 602
Inglis & Hunter, Toronto, Ont..... 675
Inglis, Thos., Toronto, Ont..... 667
Ingram, Chas. F., Wilkes-Barre, Pa..... 284
Inman Bros., N. Y. City..... 642
Inman Geo. B., N. Y. City... 143, 161, 227, 482, 483
Inman, W. F..... 362
Irish & Quinn..... 249
Jackson, T., Oregon, Ill..... 451
Jackson, Wm..... 41
Jacobus, D..... 496
James David J., Salt Lake City, Utah..... 646
Jaret, Pharon*.....246, 268
Jenness, A. R., Fryburg, Me..... 7
Jervis, Jno. B*.....39, 174, 653, 659
Jobe, S., Kansas City, Mo..... 516, 535, 561
Johnson & Flad, St. Louis, Mo..... 450
Johnson, J..... 347
Johnson, J. B., St. Louis, Mo.....508, 512, 515, 557
Johnston, P. D..... 449
Jones, A. N..... 507
Jones, D. B., Visalia, Cal 639
Jones Freehold, Caribou, Me..... 6
Jones, Geo. L., Braddock, Pa..... 224
Jones, J., Wichita, Kans.....341, 520
Jones, J. A., Great Bend, Kans.....513, 525, 584
Jones, J. T.....561, 573, 580, 581, 583
Jones, R. A..... 606
Jordan, C. E., Portland, Me..... 27
Jordan, F. M., Auburn, Me..... 1
Josel, F. E..... 443
Joy, Moses, Jr., Milford, Mass.....62, 69
Judson, C. E..... 271
Kames, Joshua..... 230
Keating & Sheehan. Detroit, Mich 408
Keating, E. H., Halifax, N. S.....,650, 653, 654, 656
Keating, P. W..... 408
Keefer, G. A..... 682
Keefer, Thos. C., Ottawa, Ont., 659, 667, 669, 672, 674, 676.
Keith, G. T., Olean, N. Y..... 377
Kelley, M. P..... 577
Kelley, Thos 638
Kelly, Jas. B 417
Kenley, Wm. L., Balto., Md 292
Kennedy, A. H., Rockport, Ind.....358, 398
Kennedy, Jno 673, 676
Kennedy, Wm., Owen Sound, Ont.....654, 671, 679
Ketcham, A. R., Kansas City, Mo.....322, 347
Kiersted, W., Kansas City, Mo., 482, 507, 527, 530. 537.
King, E. W., Gt. Falls, Mont..... 553
King, Jas..... 652
King, Jno. H., Belvidere, N. J..... 196
Kinley, J. R., Chicago, Ill..... 462
Kinney, C..... 550
Kinsey & Mahler 440
Kirby, Frank E., Detroit, Ont..... 679
Kirkwood, Jas. P.*.....52, 60, 80, 127, 132, 175
Kluegel, C. H., Ontario, Cal..... 616
Knapp, Louis H., Buffalo, N. Y.....133, 661, 674
Knight, C. W., Rome, N. Y., 134, 146, 182, 199, 218, 233, 237, 241, 270, 280.
Kuhn, W. S., Pittsburgh, Pa..... 441
Kulchling, Emil, Rochester, N. Y 144
Lader, Mr 599
Ladoo, J. W..... 218
La France Steam Fire Engine Co., Elmira N.Y. 156
Lamb, J. Warren, Cooperstown, N. Y..... 171
Lamson, D. L..... 7
Landreth & Fitzgerald, Schenectady, N. Y..... 178
Lane, Moses*.....132, 264, 316, 470
Lang, W. H., Burlington, Vt 21, 26, 32, 155
Langdon, W. F..... 24
Langford, J. T., 70 Kilby st., Boston, Mass..49, 60
Lavery, W., Dundas, Ont..... 673
Latimer, Geo. A..... 532
Latrobe, Benj. H..... 258
Laurin, Jos 657
Leach, Jas., Fulton, Mo..... 555
Leach, Sam'l B..... 184
Ledlie, Chas. H., St. Louis, Mo., 321, 345, 436, 557, 578.
Lehman, B. B., Lebanon, Pa..... 245
Lehr & Emery, Allentown, Pa..... 233
Lehr, S. D., Allentown, Pa..... 274
Leisher, E..... 596
Leland, Geo., Providence, R. I..... 33
Lesage, Louis,* Montreal, P. Q..... 659
Lesley, C. P..... 615
Lewis, I. I., Ketchum, Ida 649
Lewis, Sam'l..... 251
Libby, B. C..... 588
Lilly, Edw., Mankato, Minn..... 498
Lipscomt, Gordonsville, Va..... 302
Little, Horace..... 269
Locke, Frank B., Salmon City, Ida..... 73
Lockett & Fuller..... 346
Lockett, S. H., New York City, 335, 389, 398, 401, 432, 438, 456, 512, 517, 521, 532, 565.
Lockwood, Jno., N. Y City....150, 153, 154, 162, 172
Lockwood, Jno. C., Islip, N. Y..... 153
Lor, Henry..... 663
Lovell. Thos. C., Fitchburg, Mass.....53, 54
Low, Emile, Tazewell, Va..... 385
Low, G. P..... 385
Low, J. M., Kingston, N Y..... 180
Lowe, Moses..... 72
Loweth & Curtis, St. Paul, Minn ..... .462, 492
Loweth, Chas. E., St Paul, Minn ..... .495, 543
Lowry, Jos L., Pittsburgh, Pa..... 361
Lund, Chas..... 24
Lund, Chas. C..... 17
Lusk, Jas L., Wash, Mo..... 299
Luther, R. C., Pottsville, Pa..... 236
Lynch, M. L., Galveston, Tex.....571, 583
Lythe, F. E..... 218
Macklin, H. C., Roanoke, Va..... 301, 311
MacRitchie & Nichol, Chicago, Ill..... 404
Madden, D. W., Tulare, Cal..... 638
Maguire, Edw..... 497
Mahlo, Emil 358
Mahoney, J. F 642
Makins, Jno..... 669
Manning, Chas. P., Baltimore, Md..... 290
Manning, Robt. K..... 306
Manthey, W.*..... 350
Marble, W. M..... 252
Marsh, Geo..... 111
Marsh, Jas. J..... 149
Marsh, Jno. J., No. Adams, Mass..... 48
Marshall, G. A., Darlington, Wis..... 463
Marshall, G. M..... 467
Martin, J. H..... 463
Martin, J. M., Salem, Ore..... 613
Martin, Jno., St. John's, N'f'd.....656, 657
Martin, Jno. P., Xenia, O.....373, 385, 386
Martin, M. C..... 552
Martin, Robt. K., Baltimore, Md., 238, 289, 290, 292, 294.
Martin, T. F. Walsenburg, Colo..... 600
Martineau, Jas. H..... 646
Masson, F. S., Petrolia, Pa..... 258
Mason, M..... 85
Mason, W. A., Somerville, Mass..... 36
Masten, C. S., Phoenix, Ariz..... 560
Masten, W. C..... 560
Mathers, M. W., Glenwood Sp'gs, Colo.....587, 593
Mathews, J. E..... 282
May, L. D 509, 527
McAlpine, Wm. J.* 52, 70, 71, 162, 170, 437, 659
McAuley, A. L., Morrisonville, Ill..... 450
McBride, H. J..... 604
McCampbell, W. E..... 522
McCanne, D. J., Gunnison, Colo 594
McClelland, D., Wellsburgh, W. Va..... 313
McClure, J. O., Warsaw, N. Y.....178, 188
McComb, Chas. A 665
McConnell, Walter F., Boston, Mass..... 60
McCormick, A. H., Parsons, Kan, 513, 521, 522, 560, 565, 568.
McCormick, Jno., Lexington, Va..... 303
McCollough, Jr., Jas..... 282
McDonnell, R. W..... 367
McDonnell, H. M..... 142
McDougal, Jno., Montreal, P. Q..... 659
McDowell, Jno..... 388
McElroy, Sam'l, Brooklyn, N. Y..... 132
McFarland, Chester.....375, 421
McFarlane, P..... 676

P. D. WANNER, Chairman. A. H. MELLERT, Secy. & Treas.

Mellert Foundry and Machine Co., Ltd.,

And READING FOUNDRY COMPANY, Limited,

READING, PA.,



FLANGE PIPE AND SPECIALS,

STOP VALVES, FIRE HYDRANTS AND LAMP POSTS.

Structural Work, Car and Railroad Castings, the Canadian Turbine.

GENERAL FOUNDRY AND MACHINE WORK.

JOHN FOX, SELLING AGENT,

160 BROADWAY, - NEW YORK.

Sheet Steel and Iron Water Pipe,

Well Casing, Iron Tanks, Irrigating

Hydrants, Water Gates, etc.,

For Water-Works, Hydraulic Mining, Irrigation, etc.

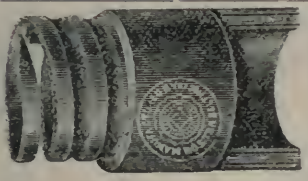
SIZES FROM 4 INCHES TO 44 INCHES.

ESTIMATES CHEERFULLY GIVEN ON RECEIPT OF SPECIFICATIONS.

LOS ANGELES, CAL.

Engineers.
McFarland, R. 341
McGinley, Ed. 271
McGinly, E. P., Danville, P. Q. 282
McGuire, W. 678
McKenzie, T. H., Southington, Conn. 113, 114, 120
McLain, C. F., Omaha, Neb. 529, 533, 538
McLaughlin, J. D. 361
McLeary, Jno., Walston, Pa. 281
McLennan, C., Chicago, Ill. 449
McMillan, Jas. A. 242
McMullin, J., Kennett Square, Pa. 242
McNair, Thos. N., Hazleton, Pa. 246
McQuillan & Co., Toronto, Ont. 670
McRea, S. P., Freeport, Pa. 236
McReynolds, ——, Cleveland. 361
McRitchie, Chas., Chicago, Ill. 567
McWilliams, H. H. 695
McWilliams, Jas. A. 605
Meeker, C. H. 531, 594
Meigs, M. C. 297
Merchant, Ira., Duluth, Minn. 433
Merrill, G. G. 81
Metesser, Louis, New Orleans, La. 569
Meyers, Geo. F. 581
Meyers, Lewis. 607
Meyers & Son. 419
Michigan Pipe Co., Bay City, Mich., 182, 397, 400, 403, 407, 410, 412, 415, 424, 425, 428, 429, 463, 475
Middleton, Thos. 356
Miller & Burket. 251
Miller, A. C., Minneapolis, Minn. 497
Miller, Alvin N. 326
Miller, C. A., Rawlins, Wyo. 549
Miller, Donnell, Cheyenne, Wyo. 320, 549
Miller, F. W. 148
Miller, H. E., Bellevue, Ida. 648
Miller, Thos. S., Andes, N. Y. 129
Millet, R. D. 540
Milne, Alex., Aylmer, Ont. 664
Milner, W. S., Birmingham, Ala. 333
Mitchell, G. A., Cedar Rapids, Ia. 492
Moak, Samuel, Amsterdam, N. Y. 143
Moffett, Hodgkins & Clarke, Syracuse, N. Y., 126, 131, 135, 144, 148, 161, 188, 317, 340, 368, 410, 421, 461, 463, 474, 500, 666, 668.
Moffett, W. R., Wilkes Barre, Pa. 240
Monro, Thos., St. Catharines, Ont. 670, 674
Monroe, Harvey E. 425
Monroe, J. Albert. 546
Moore, Arthur C., Sturbridge, Mass. 43, 93
Moore, A. G., Cincinnati, O. 361, 364, 366
Moore, Chas. K., New York City. 148, 178
Moore, Jno. M., London, Ont. 675
Moore, M. M., 111 Liberty St., N. Y. City, 196, 316, 390, 462, 464.
Moore, R. 218, 564
Moorehead, T. S., Milton, Pa. 519
Morey, P. F., Pendleton, Ore. 612
Morgan, Edgar M. 636
Morgan, Geo. C., Chicago, Ill., 367, 395, 405, 422, 427, 428, 433, 434, 440, 445, 447, 448, 451, 452, 453, 454, 456, 458, 459, 462, 474, 477, 486, 492, 499, 503, 504.
Morgan, S. H. 160
Morison & Corthell, Chicago, Ill. 546
Morris, Wm. E. 224, 255, 260
Morrison, Ellis, N. Y. City, 229, 273, 286, 368, 384, 391
Morrison, L., Salem, Va. 308
Morrow, Jas. A., Hornellsville, Tenn. 344
Muenscher, E. W., Grand Rapids, Mich. 413
Muirhead, J., Morgan, Tex. 580
Mullins, Robt. T., N. Y. City. 142
Murdock, Geo. 61
Murdoch, Gilbert, St. John, N. B. 650, 651
Murphy, Howard, Philadelphia, Pa. 206, 216, 308
Murty, Jr., W. S. 619

Nash, G. D. 34
Neilson, Robt. 222
Nelson, Jno. W., Goldsborough, N. C. 316
Nelson, W. H., McPherson, Kan. 517
Nesbit, J. J., Larned, Kan. 491, 516
Nettleton, E. S., Denver, Colo. 591
Newman, Emil, Porterville, Cal. 628
Newman, G. O. 631
Newman, J. J., Providence, R. I. 12
Nichols, E. M., Madison, Wis. 468
Nichols, H. K., Philadelphia, Pa. 236
Nichols, Jno., Georgetown, Ky. 353
Nier, Jno. W., Kansas City, Mo., 439, 505, 508, 510, 511, 513, 514, 515, 516, 518, 519, 523, 535, 561, 580.
Nier, Hartford & Mitchell, Kansas City, Mo., 335, 505, 566
Noble, Jno. T., St. Louis, Mich. 427
Norman, Geo. H., Newport, R. I. 37, 51, 72, 96, 99
Northway, Wm. R., Chicago, Ill. 439, 459
Norwalk Water Pipe & Const. Co., Norwalk, Conn. 175
Noyes, Albert F., Newton, Mass. 72
Oberg, Gus. 426
O'Connor, Chas. 467
O'Connor, Jno. 603
Odell, Frederick S., N. Y. City. 205
Ogden, Jno. L., Philadelphia, Pa. 263
Ogdin, Saml.,* Philadelphia, Pa. 235
Olmstead, A. 323
O'Neil, Jas. A., Indianapolis, Ind. 507
Orchard, H. 604
Orton, C. 504
Orton, M. C. 571, 576
Osborne, Jno. 123
Osmer, Walter A., Logansport, Ind. 394
Ostrander, O. H. 229
Ottmann, Louis, Mamaroneck, N. Y. 160
Owen, Jas., Montclair, N. J. 206
Paine, C. W. 535
Palmer, Ed. 545
Parker, W. S., N. Y. City. 136, 159, 189, 429
Patterson, Geo. W. 190
Patton, T. W., Asheville, N. C. 314
Pearson, H. C., Grand Haven, Mich. 153
Pearson's, Galen W., Kansas City, Mo., 2, 169, 174, 347, 418, 420, 507, 509, 517, 520, 521, 556, 558, 560, 595.
Peck, E. H., Coolidge, Kans. 509
Pecke, F. S., Watertown, N. Y. 178, 666
Pennington, B. C., West Burlington, Ia. 493
Perin, C. M. 591, 599
Perkins, N. W. 516
Perkins, P. B., Springfield, Ill., 491, 521, 554, 555, 557, 560, 564, 569.
Perkins, P. C., Michawaka, Ind. 395
Perry, Wm. 668
Peters, Hurd. 619
Peters, Malcolm, Philadelphia, Pa. 202
Peterson, B. W., Wheeling, W. Va. 313
Peterson, Peter Alex, Montreal, Can. 676, 678
Petry, A. 352
Pettee, Wm. E., Lakeville, Conn. 79, 105, 109
Peyton, G., University of Virginia, Va. 310
Pfifenberger, Lucas. 458
Phelps, Mr., Kalamazoo, Mich. 403
Phelps, Geo. W. 406
Philbrick, Edw. S* 43
Phillips, R. C. 369
Phillips, Wm. 322
Phinney, H. W. B., West Fall Brook, N. J.* 212
Phipps, D. Goffe, New Haven, Conn. 118, 124
Phipps, E. H., New Haven, Conn. 113
Pierce, C. H., Providence, R. I. 58, 90, 107
Pierson, Geo. H., Milton, Pa. 214, 251
Pigg, L. H., Chatham, Va. 300
Pike & Sturtevant. 500
Pike, D. W. 520
Pike, R. D. 461
Pilchford, J. B. 611
Pillsbury, J. L. 362
Pilsbury, Mr. 482
Pollard, Wm. D. 267
Porch, Jas. Chebanse, Ill. 434
Potter, J. W. 496
Potter, T. Z., Housatonic, Mass. 58
Potts, Chas. 215
Powers, Jas. P., Brooklyn, N. Y. 331
Price & Butler. 655
Primm, W. W., St. Louis, Mo. 578
Prince, Edw, Quincy, Ill. 454
Pritchard, P. M. 528
Provines, W. G. 518
Publes, A. O. 378
Purdy, J. H. 441
Quigley J. B., St. Louis, Mo. 505, 556, 564
Raeder, F. Wm., St. Louis, Mo., 435, 444, 450, 510, 514, 516, 561, 589.
Rafter, Geo. W., Rochester, N. Y. 144
Ramsey, J. W., Beaver Falls, Pa. 220
Rand, A., Oakdale, Cal. 625
Rand, J. B. G. 152
Rand, J. B. S.* 175
Randall, J. J. R., Rutland, Vt. 29, 34
Ranson, Dan'l. 596
Rawley, H. C. 119
Raymond & Campbell, Middletown, Pa. 240
Raymond, Geo., Fitchburg, Mass. 53
Raymond, J. C. W., Washington, D. C. 191, 299
Read, A. J. 181



Established 1828.

Rubber Suction Hose. "Smooth-Bore" Rubber Suction Hose.

BOSTON BELTING CO.,

Original Manufacturers of Every Variety of

RUBBER BELTING, HOSE,

STEAM PACKING, &c.

Also Manufacturers of all other articles of VULCANIZED INDIA RUBBER for Mechanical and Manufacturing Purposes. RUBBER VALVES of all descriptions for Hydrants, Pumps, Engines, Steamships, etc.

256 to 260 Devonshire St.
BOSTON, MASS.

100 Chambers Street,
NEW YORK CITY.

C. H. MULLIGAN, Superintendent. E. B. JENNINGS.

R. F. HAWKINS IRON WORKS,

SPRINGFIELD, MASS.,

Builders of Stand Pipes,

Steam Boilers, Tanks, Iron Castings, Bridges, Bolts, Iron Roofs, etc.

R. F. HAWKINS, Proprietor.

S. E. NOBLE, Prest. JNO. E. WARE, Secy. & Treas. R. F. CARTER, Supt.

The Anniston Pipe Works,

MANUFACTURERS OF

CAST IRON WATER & GAS PIPE,

ANNISTON, ALA.

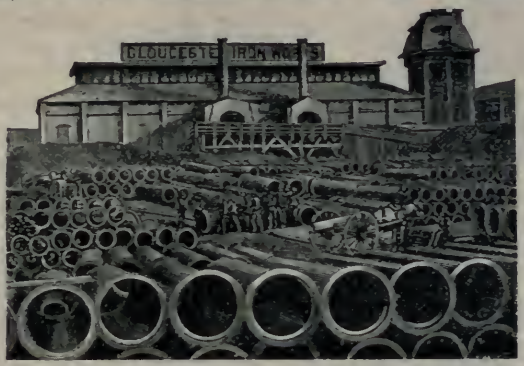
Engineers.
Reed, F. H. ... 639
Reed, H. W. ... 328
Reeves, Jno ... 220
Reid, H. I., Colorado Springs, Col. ... 589
Reynolds & Morgan, Cuba, N. Y. ... 149
Reynolds, N. L., Bluefield, W. Va. ... 311
Reynolds, S. H., St. Catherine's Ont. ... 670
Rhodes, Ben. J., Niagara Falls, N. Y. ... 168
Rhodes, D. H., Kingman, Kan. ... 514
Rice, H ... 220
Rice, L. F ... 60
Richards, W. H., New London, Conn. ... 116
Richardson, A. A., Lincoln, Neb., 479, 485, 517, 520, 522, 528, 529, 530, 531, 532, 534, 535, 536, 537, 538
Richardson, Jas. A. ... 597
Richardson, W. D., Springfield, Ill. ... 578
Rider, W. B., So. Norwalk, Conn., 106, 110, 111, 112, 120, 121, 122, 141, 152, 159, 170, 174, 175, 179, 182, 187, 189, 210.
Rigby, H. P. B. ... 349
Rigley, H. E. ... 227
Roberts, W. N. ... 137
Robichon, P. N. ... 663
Robinson & Tracy, London, Ont ... 669
Robinson, A. A., Topeka, Kan. ... 595, 601
Roe, W. E. ... 225
Root, L. F., Westfield, Mass. ... 91
Rotch, Wm., Boston, Mass. ... 52
Ross, Thos. ... 28
Rossi, J. C. ... 138
Rosewater, Andrew, Omaha, Neb. ... 529
Rowe, S. M. Albuquerque, N. M ... 601
Rowland, Geo. H. ... 378
Rowley, H. W ... 551
Rudiger E. A., San Antonio, Tex. ... 532
Ruggles, W. W. ... 204
Russel & Alexander, Colorado Springs. ... 598, 601
Russell, S. B. ... 564
Russell, W. S., Grand Forks, N. Dak. ... 547
Rutherfoord, Jno. W., New York City. ... 110, 562
Rutter, J. C., Lansford, Pa. ... 245, 276
Saleno, S. V., Bay City, Mich. ... 362, 397, 407, 414, 587
Sales, W. A. ... 612
Sanford, W. C., Stockton, Kan ... 523
Sargent, A. F. ... 66
Saulsburry, Jno. ... 449
Savier. S. D. ... 502
Sawyer, E. B. ... 597
Sawyer, Edw. ... 72, 87
Sawyer, Solon. ... 410
Schaeffer, Jno. ... 223
Schaff, Frederick ... 72
Schealer, Jno. G. ... 223
Schefold, Frank, New Albany, Ind ... 396, 439
Schellner, Jacob ... 273
Schinneller, J., Pittsburgh, Pa ... 224
Schlesinger, A. D., College Point, N. Y. ... 138
Schreuneller, Jacob, Pittsburgh, Pa ... 220
Schroeder, Chas., Columbus, Neb., 528, 529, 532, 535, 536.
Schussler, Hermann, San Francisco, Cal., 633, 635, 638, 645.
Schuyler, Jas. D., San Diego, Cal. ... 624
Scofield, H. G., Bridgeport, Conn ... 121
Scott, Jno., Philadelphia, Pa. ... 242
Scovel & Irwin Const. Co., Nashville, Tenn. ... 338
Scowden, L. A. ... 357
Scowden, Theo. R* ... 355, 357, 381, 394
Sears, C. E., Puyallup, Wash ... 605
Sears, Walter H., Plymouth, Mass. 35, 39, 93, 98, 502
Sekell, A. C., Grand Rapids, Mich. ... 419, 422
Serry, L. L., Stoneham, Mass. ... 66
Seversedge, A., Asheville, N. C. ... 314
Seymour, C. W. S., Hingham, Mass. ... 56
Snyder & Williams, Dayton, O. ... 400
Soper, E. S., Charlotte, N. C. ... 315
Shaben, August ... 607
Shackelford, R. M. ... 620, 627, 638
Shedd & Sawyer, Boston, Mass. ... 67, 91
Shedd, J. Herbert, Providence, R. I. 1, 3, 11, 102, 104, 524.
Shelley, C. F., Lockport, N. Y. ... 183
Shepherd, O. L. ... 219
Sherman, W. B. ... 589
Sherwin, J. W. F. ... 235
Shryock, S. ... 641
Shuttleworth, C. J. ... 231
Sickles, F. E. ... 559
Simmons, J. ... 507
Simmons, Jos. ... 559
Simmons, J. S. ... 506, 516, 518, 593
Simpson, Chas. P. Sullivan, Me. ... 15
Simpson, E. S. ... 398
Sink, W. D ... 617
Slade, Jas ... 80, 290
Slaney, Jno. M., N. Y. City ... 554
Slaw, J. C. ... 288
Slaymaker, S. M. ... 243
Slemons, Jas. ... 410
Slingluff, Jno., Norristown, Pa. ... 255
Smalley, E. D., Canastota, N. Y., 129, 130, 134, 135, 140, 175, 176.
Smedley, E., Dubuque, Ia. ... 342, 484, 500
Smith, A. T. ... 226
Smith, Chas. A., St. Louis, Mo. ... 35, 556, 562
Smith, C. E., Chateaugay, N. Y. ... 136
Smith, E. F. ... 267
Smith, Erastus W ... 342
Smith, F. N. ... 136
Smith, Geo. P., Tonawanda, N. Y. ... 185, 407
Smith, H. B. ... 682
Smith, I. W. ... 604
Smith, Isaac W., Portland, Ore. ... 607
Smith, John B. ... 231
Smith, John R. ... 84
Smith, Willard ... 209
Smith, W. A. ... 53
Springfield, J. F., Rochester, N. H. ... 25
Stair, W. H. ... 512
Stanley, O. G., 113 Devonshire St., Boston, Mass. ... 87, 95
Starr, Jr., Jesse W., Philadelphia, Pa. ... 4
Starr, Samuel C. ... 371
Stauffer, D. McN., New York City. ... 307, 525
Staunton, E. M. ... 136
Steck, Henry ... 271
Stein, Albert, Richmond, Va. ... 303, 307, 342, 348
Stephen, Arthur B. ... 666
Stephens, Benj. F., Flatbush, N. Y. ... 143, 147, 379
Stevens, C. V., Somonauk, Ill ... 456
Stevens, G. C. ... 573
Stevens, Geo. E ... 391, 392
Stevens, Jos. ... 489
Stevenson, C. L ... 39
Stevenson, Jno. B. ... 230
Stickney, Dean ... 360
Stilson, W. B. ... 117
Stirtan, J. W., Nanaimo, B. C. ... 681
Stookey, M. T., Belleville, Ill. ... 433
Storrs, Dan ... 516
Strang, A. L., Omaha, Neb. ... 527
Straw, L. W., Danville, Ill. ... 440
Strawn, J. B., Salem, O. ... 369, 373
Stripe, W. C., Keokuk. Ia. ... 485, 491, 540
Studley & Co., E. G., Grand Rapids, Mich. ... 426
Sturges & Bryant, Salt Lake City, Utah. ... 646
Sturtevant, Geo. W., Minneapolis, Minn. ... 528
Surtees, Robt., Ottawa, Ont. ... 658, 673
Sutherland, Geo., Blair, Neb ... 528
Sutherland, W. J. ... 643
Sutphin, E., Sherman, Tex. ... 580
Sutter, Frank, Biloxi, Miss. ... 339
Swan, Chas. H., Boston, Mass. ... 80
Swift, McKee ... 114
Tabor, Capt ... 191
Talbot, T. J. ... 519
Taylor, C. F. ... 446
Taylor, Harry ... 431
Taylor, L. A., Boston, Mass. ... 78, 85
Taylor, W. W., Upper Sandusky, O. ... 207, 293, 295, 296, 316, 344, 384.
Terrell & Muckle ... 330
Thayer, Wm. F. ... 18
Thomas Bros. ... 627
Thomas & Gorman, Houston, Tex. ... 571
Thomas, C. B. ... 227
Thomas, F. H., Shipskinsburgh, Pa. ... 274
Thomas, J. D. ... 581
Thomas, R. B., Clarion, Pa. ... 269
Thompson, D. P. ... 609
Thompson, Hebr. S., Pottsville, Pa. ... 236
Thurston, S. D. ... 621
Tidd, M. M., Boston, Mass. 5, 6, 7, 9, 25, 37, 38, 43, 49, 50, 56, 59, 63, 66, 67, 70, 78, 87, 89, 92, 93, 94, 656.
Tingley, Geo. C., Providence, R. I. ... 100
Titcomb, J. S., Denver, Col. ... 588
Todd, F. H., St. Cloud, Minn. ... 495
Todd, H. C., Calais, Me. ... 5
Toothaker, W. F. ... 611
Topp, T. M. ... 617
Tower, A. B., Holyoke, Mass. ... 57
Tower, D. H., Holyoke, Mass. ... 57
Tracy, E. H. ... 165
Tracy, Thos. H., London, Ont. ... 664, 669, 680

GLOUCESTER IRON WORKS,

Office, No. 401 Chestnut Street, Philadelphia, Pa.

Samuel R. Shipley, President.

David S. B. Chew, Treasurer.



Jas. P. Michellon, Secretary.

William Sexton, Superintendent.

CAST IRON GAS and WATER PIPES,

1½, 2, 3, 4, 6, 8, 10, 12, 14, 16, 20, 24, 30, 36, 40 and 48 inches Diameter.

Cast Iron Flange Heating and Steam Pipes,

2 to 48 inches diameter.

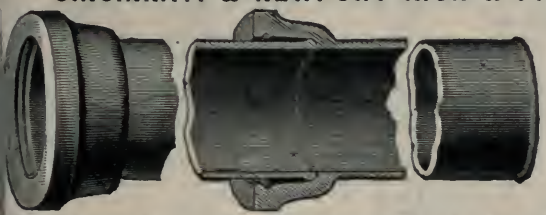
Fire Hydrants and Stop Valves for Water or Gas, all Sizes.

ALL PIPE PROVED BY HYDROSTATIC PRESSURE.

THE ADDYSTON PIPE & STEEL CO.

Proprietors of the Business and Works formerly operated by the

CINCINNATI & NEWPORT IRON & PIPE CO., Cincinnati, Ohio.



Matthew Addy, Pres.
W. P. Anderson, V.-Pres.
B. F. Haughton, Secretary.
C. H. Domhoff, Treasurer.
W. L. Davis, Contracting Agent.

WORKS:

ADDYSTON, O.

NEWPORT, KY.

For Water, Gas, Railroad and Turnpike Culverts and Sewers, Branch Castings of all descriptions; Hydraulic Cylinders. General Machine Castings and Flange Pipe.

SPECIALTY : PIPES FOR NATURAL GAS AND FUEL GAS.

Geo. Ormrod, Man. & Treas. Emaus, Pa.

EMAUS PIPE FOUNDRY.

John Donaldson, Pres. 226 Walnut St., Phila., Pa.

DONALDSON IRON COMPANY.

MANUFACTURERS OF

AND

SPECIAL CASTINGS

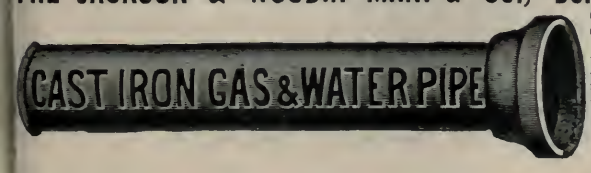
FOR

WATER AND GAS.

ALL PIPES CAST VERTICALLY.

Emaus, Lehigh Co., Pa.

THE JACKSON & WOODIN MANF'G CO., Berwick, Columbia Co, Pa.



C. R. WOODIN, Prest.
C. H. ZEHNDER, Vice-Prest. and Gen. Manager.
WM. F. LOWRY, Treas.
FRED'K H. EATON, Secy.
H. F. GLENN, Gen'l Supt.

FREIGHT CARS, CAR WHEELS, BAR IRON, Special Castings.

Engineers.
Trask, F. E., Ontario, Cal..... 626
Truesdale, C. H., Boston, Mass..... 78
Trump, E. D., Jersey Shore, Pa..... 241
Trumpor, W. H..... 600
Tubbs, J. Nelson, Rochester, N. Y..... 145, 161, 176
Tucker, F. E..... 549
Turner, Fremont, Nevada, Ia..... 489
Turner, Jno. H..... 332
Turner, Robt., St. Thomas, Ont..... 675
Tuttle, E. A..... 629
Tyson, A. Harvey, Reading, Pa.....248, 268
U. S. Wind Engine and Pump Co., Batavia, Ill., 431, 435, 478, 524.
Van Buren, Robert, Brooklyn, N. Y.....132, 133
Van Doren, J. I., Phoenix, N. Y..... 173
Van Harlingen, M., Philadelphia, Pa..... 255
Vanier, G. E., Montreal, Que..... 663
Vanier, J. E..... 657
Van Liew, E. S..... 429
Van Volkenburg, J. J., Worcester, Mass..... 34
Vaughan, L. M. D..... 528
Venable, S. F., Asheville, N. C..... 314
Venables, J. H..... 679
Versey, E..... 257
Von Schmidt, H. W..... 644
Voorhis, Wm..... 169
Wagner, E. C., Girardville, Pa..... 237
Wagner, L. J., Rome, N. Y..... 325
Walker, J..... 180
Walkenburg, J. J., Worcester, Mass..... 79
Walker, Jno. M., Lawrence, Kan., 389, 398, 401, 456, 517, 555.
Walker, J. S..... 333
Walker, M., Fenton, Mich., 403, 404, 408, 411, 416, 419, 241, 423, 424.
Walker, T. S., Gonzales, Tex..... 577
Ward, C. D., Syracuse, N. Y..... 309
Ward, Jno. F., Jersey City, N. J..... 203
Ward, L. B., N. Y. City..... 309
Ware, A..... 673
Ware, Geo..... 680
Waring, W. S..... 602
Warner, J. W., Oneida, N. Y..... 170
Waron, Major..... 516
Warren, Jno. E., Cumberland Mills, Me..... 10
Wassell, E..... 655
Waterous Engine W'ks, Brantford, Ont..... 679
Waters, Jas..... 499
Watson, Ed. A., Springfield, Kan..... 523
Watson, W. S., Beaver, Pa..... 220
Wattles, J. S..... 488
Watts, Sylvester, St. Louis, Mo..... 576
Weaver, G. Norman, Newport, R. I., 54, 97, 98, 151, 181.
Weed, O. W..... 666
Weir, E. G., Belvidere, N. J..... 196
Weir, J. C..... 476
Weir, Wm. C.*.....352, 368, 379, 479, 486, 489
Welch, Henry..... 439
Welton, Nelson J., Waterbury, Conn.....73, 123
Welton & Bonnett, Waterbury, Conn..... 124
West, Jno., Mason City, Ia..... 487
Westcott, Nelson, Candalaria, Nev..... 643
Weston, E. W., Scranton, Pa..... 271
Weston, Jas. A..... 17
Weston, Jos. A., Concord, N. H..... 17
Weston, Theo..... 141
Wetherill, Lyman, Newington, Conn..... 115
Wetherill, Price..... 279
Wheeler, E. P..... 443
Wheeler, Wm., 89 State St, Boston, Mass., 42, 47, 50, 89.
Wheeler & Parks, 89 State St., Boston, Mass., 3, 18, 110, 118, 119, 122, 330.
Wheelock, Charles G., Orangeville, Ont..... 66
Whitby, Wm..... 26
White, C. A., St. Paul, Minn..... 33
White, C. W..... 53
White, S. J., La Grande, Ore..... 61
White, T. R..... 32
White, Wm. H., N. Y. City..... 33
Whitelaw, John, Cleveland, O..... 36
Whiting, S. B..... 23
Whitling, Daniel, St. Petersburgh, Pa..... 27
Whitman, J. H..... 30
Whitman, Thos. J., St. Louis, Mo., 347, 354, 436, 502, 505, 517, 558.
Whitmer, J. F..... 42
Whitney, Geo. E..... 13
Whittemore, Jr., A..... 1
Whittemore, Walter T., No. Attleborough, Mass..... .
Whitwell, Wm., Hoboken, N. J..... 20
Whitwell, Wm. S.....28, 39,
Wickham, C. H., Tioga, Pa..... 27
Wilcox, Capt., Macon, Ga..... 33
Wiley, S. L., Omaha, Nebr.....54, 56, 171, 382, 49
Williams, Benczette, Pullman, Ill., 453, 475, 603, 606.
Williams, E. H..... 63
Williams, G. S., Saginaw, Mich..... 41
Williams, Jas..... 24
Williams, J. Frank, Boston, Mass..... 46
Wilmot, E. A..... 63
Wilson, C. H..... 60
Wilson, R. H., Washington, Pa..... 28
Wilson, Robt. H., Saltsburgh, Pa..... 28
Wilson, W., Uxbridge, Ont..... 67
Wilson, Wm. W.*..... 19
Wilson & Smith, Saltsburgh, Pa..... 28
Wilson Bros. & Co., Philadelphia, Pa.....241, 26
Wiltsy, Myron..... 56
Winchester, G. C..... 3
Wingfield, Nisbet, Chattanooga, Tenn..... 34
Winslow, S. J..... 9
Wintyen, Wm. J., Doylestown, Pa..... 23
Witmar, T. F..... 44
Wolcott, E., Jacksonville, Ill..... 44
Wolcott, Geo. D, Jackson, Mich..... 40
Wood, A. B., Payallup, Wash..... 60
Wood & Co., R. D., Philadelphia, Pa.....29, 21
Wood, W. H., St. Paul, Minn..... 54
Woolf, A..... 62
Woolston, Geo. F., New York City.....552, 60
Worthen, Wm. E., New York City.112, 138, 158, 30
Worthington, Henry R..... 32
Wortman, Geo. W..... 42
Wright, E. T., Los Angeles, Cal..... 61
Wright, T..... 61
Wyche, D. G., Dana, Wyo..... 54
Wyche, T. J., Dana, Wyo..... 51
Yates, P. K., Natchez, Miss..... 31
Yocum, Jacob H..... 32
Young, A..... 61
Young, A. L..... 8
Young, Jno., Geneseo, N. Y..... 14
Young, J. Marshall, Easton, Pa.213, 220, 245, 257, 27
Young, Jno. P., Manchester, N. H..... 2
Young Bros., Philadelphia, Pa..... 22

CONTRACTORS.

[Includes sub.-contractors.]

Ahrens, Howard E., Reading, Pa..... 238
Aldrich & Hill, Ware, Mass..... 88
Allen, C. D., Westfield, Mass..... 91
American Construction Co., Philadelphia, Pa., 271, 282.
American Pipe Mfg. Co., Germantown, Pa., 213, 241, 269.
American Water & Gas Works Co..... 478
American Well Works Co., Aurora, Ill..... 494
Arbuckle, Frank B., Denver, Col..... 595
Archer, Joseph, Quebec, P. Q..... 660
Armstrong, Geo..... 246
Arnold, B. C..... 616
Atkins & Co., Geo. M., Palmer, Mass..... 38
Awalt, C..... 296
Ayrault & Co., Tonawanda, N. Y..... 136
Barrett Co., Jno., Portland, Ore..... 603, 61
Barry & Smith, Richmond, Va..... 30
Barthold & Co., L..... 24
Bartlett, C. T., Evanston, Ill..... 45
Bartlett, Jas., Windsor, Ont..... 67
Bartowe, G. W., Seneca Falls, N. Y..... 18
Bassett Bros., Buffalo, N. Y., 128, 131, 137, 147, 172, 173.
Bates & Co., J. Walker, 32 Pine St., N. Y. City, N. Y..... 56
Baum, J. W., Atlanta, Ga.....322, 32
Beach, G. E., Minneapolis, Minn..... 48
Beauchemin & Sons, Sorel, P. Q.....658, 66
Beckwith & Quackenbush, Herkimer, N. Y., 150, 298.
Beemer, H. T., Montreal, Can..... 66

COFFIN & STANTON,

BANKERS,

NEW YORK:
72 Broadway.

LONDON:
47 Old Broad St., E. C.

DEALERS IN

Bonds of States,

Municipalities,

— AND —

Corporations.

Ripley & Bronson,

WATER WORKS SUPPLIES,

Cast Iron Water and Gas Pipe,

Fire Hydrants, Gate Valves, Pig Lead, Packing Yarn, Yard Hydrants and Street Washers, Service and Valve Boxes, Lawn and Drinking Fountains, Fire Hose and Fire Department Supplies.

Write for Catalogue and Prices.

800 NORTH SECOND STREET, ST. LOUIS.

STEPHEN E. BABCOCK,

Civil and Hydraulic Engineer.

CONSTRUCTION OF

Water-Works

A SPECIALTY.

LITTLE FALLS, NEW YORK.

ISAAC S. CASSIN, C. E.,

Late Chief Engineer Water Department, Philadelphia.

No. 1404 North Twelfth Street,

PHILADELPHIA, PA.

Water-Works Construction, Surveys, Estimates, Drawings, Specifications, Examinations, Reports, Consultations and Superintendence in Construction of Water-Works.

J. James R. Croes,

M. Am. Soc. C. E., M. Inst. C. E.,

13 William Street, New York.

Examinations and Reports made on Projects for Water-Supply and Sewerage of Towns.

Plans and Specifications prepared and Work of Construction Superintended.

DODWELL & HOGG,

M. M. I. C. E., M. M. C. S. C. E.

Civil Engineers,

ROOM 52, IMPERIAL BUILDING,

MONTREAL, CANADA.

Surveys, Plans, Specifications, Estimates, Superintendence and Construction of Railways, Water-Works, Drainage Systems and other Public Works.

CORRESPONDENCE SOCICITED.

EMORY A. ELLSWORTH,

B. S. C. E.,

Architect and City Engineer

AND ENGINEER OF WATER-WORKS,

HOLYOKE, - - MASS.

Offers advice and designs for the construction of Water-Works and Works for Sewerage Disposal of Towns. The development and utilization of Water Power and execution of Mills. General Architectural Practice.

J. T. FANNING,

Consulting Engineer,

ST. PAUL, MINN.

SPECIALTIES:

WATER-WORKS, WATER POWERS

—— AND ——

HYDRAULIC MACHINERY.

J. LELAND FITZGERALD,

M. AM. SOC. C. E.,

Surveys, Plans and Estimates

—FOR—

SEWERAGE and WATER SUPPLY.

Construction Superintended. Attention paid to Domestic Engineering.

OFFICE AND P. O. ADDRESS,

SCHENECTADY, - - N. Y.

ALAN MACDOUGALL,

M. Can. Soc. C. E. M. Inst. C. E.

Civil and Sanitary Engineer,

Water Works and Sewerage Systems.

Sewage Disposal, Heating, Ventilation and Plumbing.

32 Adelaide St., East.

TORONTO, CANADA.

RUDOLPH HERING,

MEM. AM. SOC. C. E., M. INST. C. E.

Civil and Sanitary Engineer,

277 PEARL STREET,

Near Fulton Street, *NEW YORK.*

Designs for Water Supply and Sewerage. Construction Superintended.

NIER, HARTFORD & MITCHELL,

ENGINEERS.

Plans and Specifications for Systems of Water-Works. Construction Superintended.

Hall Building, KANSAS CITY, MO.

Richardson Block, CHATTANOOGA, TENN.

E. WOLTMANN. GEO. T. KEITH, M. Am. Soc. C. E.

WOLTMANN, KEITH & CO.,

Engineers and Contractors

For WATER-WORKS, etc.

11 WALL ST., NEW YORK.

A. L. HOLMES,

Contracting Engineer

AND BUILDER OF

WATER-WORKS AND SEWERAGE.

Patentee and Manufacturer of

HOLMES' FLEXIBLE JOINT.

Plans and Specifications Furnished.

SUBMERGED WORK A SPECIALTY.

GRAND RAPIDS, MICH.

GEORGE HORNUNG,

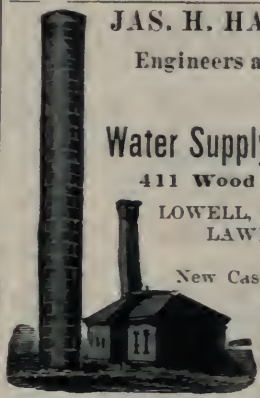
M. AM. SOC. M. E.

Hydraulic and Mechanical Engineer,

No. 30 EAST FOURTH ST.,

CINCINNATI, O.

Surveys made for Water-Works and Sewerage Systems. Plans, Specifications and Estimates of Cost furnished and Construction superintended. ***Practical Advice Given*** pertaining to the Economical Applications of steam and the Unsatisfactory Performance of Machinery of whatever character.



JAS. H. HARLOW & CO.,

Engineers and Contractors,

FOR

Water Supply and Drainage,

411 Wood St., Pittsburg.

LOWELL, MASS.,
LAWRENCE, MASS.,
BOSTON, MASS.
New Castle, Mercer, Latrobe,
Waynesburg, Etna, and Tarentum, Pa.; Aurora and Mattoon, Ill.; Eau Claire, Wis.; Minerva, O.; Canistoe, N. Y.

We Have Erected STAND PIPES

At the following places: Kankakee, Ill., 20 x 124; Cornwall, Ontario, 20 x 120; Salisbury, N. C., 20 x 100; Washington, Ind., 20 x 100; Beaver Dam, Wis., 20x84; Waterford, N. Y., 30 x 52; Berwick, Pa., 11 x 45; Homer, N. Y., 25 x 40; Cobourg, Ont., 16 x 116; Marshall, Mich., 20 x 100; Hamburg, N. Y., 16 x 125; Canton, N. Y., 20 x 72.

Sharon Boiler Works, Ltd.

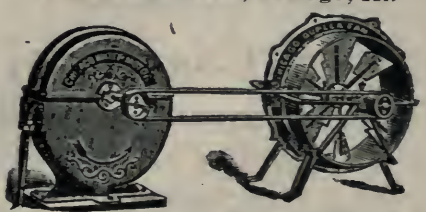
SHARON, PA.,

Stand Pipes & Boilers

For Water-Works.

CHICAGO WATER MOTOR CO.

51 Dearborn Street, Chicago, Ill.



OUR MOTOR. OUR FAN.

Water Motors for running all kinds of light machinery by water power from hydrant pressure; also MANUFACTURERS of the Duplex Ventilating Fan and Rotary Fly Fans. Catalogues Free.

Agents Wanted.

Contractors.

Beer, Isaiah 667
Beique, J. B. A. 657, 668
Bement & Co., R. B. C., St. Paul, Minn. 474, 499
Black, Forbes 653
Blackmore & Co., J. J., St. Thomas, Ont. 673
Blake Mfg. Co., Geo. F., N. Y. City, N. Y. 30
Bond & Dietrick 183
Bridges, E. L. 580
Brooks, T. 414
Brown, A. K. 489
Brown, Chas., Mohawk, N. Y. 129
Brown, Henry, Bath-on-the-Hudson, N. Y. 148
Brown, W., Cleburne, Tex. 573
Brown & Connor, Dallas, Tex. 579
Brown & Emery 242
Brown & Co., J. W., Providence, R. I. 43
Brown Bros., Mohawk, N. Y. 130, 178
Brundige, Wm. H., Florence, Ala. 335
Buehner, Philip, Portland, Ore. 462, 606
Bullock, Saml. R., N. Y. City, 227, 229, 273, 320, 336, 341, 357, 364, 368, 375, 391, 392, 400, 401, 474, 575.
Bunker, Theo. 464
Burbank, L. J. 461
Bynner, Edgarton, N. Y. City 159
Campfield & Co., W. H. 370
Carpenter & Co., S. D., Ottumwa, Ia. 487
Carroll & Co., D. W. C., Salem, N. C. 317
Casey, C. C. 326
Cassin, Isaac S., Philadelphia, Pa. 282, 283
Central Coal & Iron Co., Central City, Ky. 352
Central W. Works Const. Co., Kansas City, Mo 507
Chabot, M. 634
Chambers & Casey, Rochester, N. Y. 145, 176
Chandler Bros. & Co., Beaver Falls, Pa. 373
Chapman, W. S., Portland, Ore. 610
Chappell, D. A., Chicago, Ill. 106
Chisholm, W. M., East Liverpool, O. 314
Chittenden Bros. 297
Clark & Co., Somanauk, Ill. 456
Clarke, Ben. S., Holdredge, Neb. 520, 529, 531, 537
Clarkson, D. A., Pennington, N. J. 211
Clarkson, Jos. 213
Clifton & Co., Jno., Peru, Ind. 397
Cloud, J. A., Philadelphia, Pa. 360
Cochran, S. R., Greenville, Pa. 237
*Cody, Jas. 630
Collins, C. & H. B., Murfreesboro, Tenn. 348
Colorado Machinery Co., Denver, Colo. 588
Comegys & Lewis, N. Y. City, 389, 398, 401, 432, 456, 512, 519, 521, 532, 555.
Commonwealth Const. Co., Philadelphia, Pa. 356
Condon, P. 111
Conger, David 396
Conn. Patent Water Pipe Co., New Haven, Conn. 23, 113, 181, 121, 124
Connor, Jas., Winfield, Kan. 526
Connor, W. C., Dallas, Tex. 571
Cook & Co., E. H., Elmira, N. Y. 274
Cook & Heaton 515
Coon, A. H., Kingston, Pa. 265
Coon, W. S., Upper Sandusky, O. 384
Coon & Co., Washington, Pa. 282, 288
Coon & Mooney, Kingston, Pa. 145, 245
Cope & Maxwell, Hamilton, O 394
Cooper, T. & M., Newport, Ky. 357
Copp, Wm. 675
Corkish, Jno., Portland, Ore., 603, 605, 606, 609, 611, 614, 648, 649.
Corrigan, Thos. 559
Cosgrove, Jno., Pineville, Ky. 358
Cossette, Octave, Valleyfield, P. Q. 663
Cowell, Truman, Muscatine, Ia. 477
Cowles, Thos. 299
Crook, Horner & Co., Baltimore, Md. 296
Crouse, J. & A., Presque Isle, Mo. 12
Curlin & Palmer, Scranton, Pa. 219
Currie & Co., J., London, Ont. 676
Dacey, Daniel, Dover, N. H. 17
Dana, Geo., Brockville, Ont. 675
Daniels, Geo. W., Aurora, Neb. 527
*Daniels, Travers 486 568
Davin, Lexington, Va. 303
Davis, J. 615
Davis & Kelly 193
Dean Bros., Indianapolis, Ind. 394
Delafield, C. A., N. Y. City 190
Delfur, F. L., Carman, Ill. 493
Denison & Cowell, Muscatine, Ia., 151, 312, 357 371, 372, 379, 477, 479, 484, 485, 489, 490, 492.
Denithorne Bros., Phœnixville, Pa. 222
Dennis, H. G., New Bedford, Mass. 8
De Remer, J. R. 599
Dezeng, W. D. 145
Dixie, A. 625
Dodge, Hascal, Pittsfield, Mass. 48
Doerzbach & Duker, Oberlin, O. 378
Dougherty & Ferguson, Newark, O. 376
Drake, Wm., Springfield, Ill. 453
Drake & Bonebrake 522
Drake & Orton, New York City 576
Drullard & Hayes 156
Dull, D., New York City 339
Duncan Bros., Chattanooga, Tenn. 344
Dunham & Paine, Cleveland, O. 489
Dunn, J. H. 114
Durack & Co, P., St. Paul, Minn. 502
Durfy, Mr, Providence, R. I. 3
Dwyer, Jno., Kansas City, Mo 512
Dyer, Eph., Portland, Me. 5
Earnshaw, Peters & Scully, Cincinnati, O. 397
East Texas Water & Gas Co. 577
Eastern Const. Co., Portland, Me. 457
Eclipse Wind Engine Co., Beloit, Wis., 443, 444, 463, 479.
Ellis & Co., N. W., Manchester, N. H. 16, 20, 21
Esbach, Jno. E. 201
Fairbanks & Co., St. Louis, Mo 528
Fairbanks, Morse & Co., Chicago, Ill., 354, 394, 433, 449, 452, 462, 464, 483, 499, 503, 504, 510, 543, 545.
Farrar, Wm., Red Bank, N. J. 213
Faunce, Q. A., Quincy, Mass 68
Felton, S. K. 526, 511, 554, 536, 537, 543
Ferguson, Mitchell & Symmes 674
Ferris & Halladay, Jersey City, N. J., 8, 10, 50, 55, 87, 146, 160, 188, 203, 204, 231, 265.
Filman, B. F., Scranton, Pa. 252
Fish, D. B., Brooklyn Village, O. 362
Fisher, D. 453
Flint, Walling & Co., Kendallville, Ind 426
Foegey & Co., Washington, Pa. 282
Foote, Jno., Carbonear, N'f'd. 656
Ford, Jno., Newton, Kan. 521
Ford, W. H., Chatham, Va. 300
Foster, H. L., Pottsville, Pa. 283
Fox & Wilde, Visalia, Cal. 639
Frazer, Wm. H., Charlottetown, P. E. I. 656
Freel, Ed., Brooklyn, N. Y. 155
Freeman, W. R. 582
French, David, Syracuse, N. Y. 177
Fremont F'dry & Mach. Co. 488
Frost & Son, M. S. 359
Fruin & Co., St. Louis, Mo. 502
Fuller, L. F., Calvert, Tex. 572
Gannon, Thos. 244
Gardner, Geo. I., Belvidere, N. J. 196
Garrat & Co., W. T., San Francisco, Cal. 611
Gaylord, E. E. 540
Genung, Rider & Co., Sing Sing, N. Y. 182
George & Co., E. 406
Gerlich, G., New Braunfels, Tex. 580
Gibson, B. 672
Gill, Jno. A., E. Boston, Mass. 74
Girton, G. B., Newton, Pa. 255
Glamorgan Co., Lynchburg, Va., 299, 300, 301, 305, 309, 310.
Goohue, C. L., Springfield, Mass. 70
Goodhue & Birnie, Springfield, Mass., 16, 19, 24, 27, 36, 51, 56, 59, 61, 73, 75, 80, 82, 84, 91, 121, 122, 136, 386, 404.
Goodwin & Morrison 306
Goody, Kroutz & Perry 541
Gorman & Renckie, Dallas, Tex. 572
Gowne & Sons, Jno. 366
Granger, A. O., Philadelphia, Pa. 662
Grant, Alexander & Co. 322
Graves, J. S., Meyersdale, Pa. 250
*Gray, Carroll E., Chicago, Ill. 497
Gray, Jr., Carroll E., Chicago, Ill., 476, 556, 562, 568, 581.
Gray Bros., Milwaukee, Wis. 543, 545, 547
Groscup & Keith 571
Grubbins, Jno., Chicago, Ill. 391
Hardwicke & Ware, Buffalo, N. Y. 192, 220
Harlow & Co., Jas. H., Pittsburgh, Pa., 135, 244, 250, 277, 283, 284, 287, 376, 390, 432, 448, 464.
Harper L., Omaha, Neb. 550
Harper & Reynolds Co., Los Angeles, Cal. 621 622
Harrison & Hawley, St. Paul, Minn. 498
Harvey & Son, A., Detroit, Mich. 427
Hauxhurst & Hamlin 540
Helm, Jr., Jno., Port Hope, Ont. 674
Hendrickson, J. D., Franklin, O 370
Hennessey, Thos., Grand Forks, No. Dak. 547
Hennessy, Thos., Holden, Mass. 61, 81
*Herdic, P., Williamsport, Pa. 272

VITRIFIED PIPE

FOR

WATER-WORKS CONDUITS.

For Water-Works Conduits, where the supply can be obtained by gravity, there is no material so desirable as our

DOUBLE STRENGTH CULVERT PIPE

for the following reasons:

First: It is clean.

Second: Its cost as compared with **Iron** is about one half.

Third: It will not corrode nor rust. It is not in any way affected by the action of acids or moisture, but when once laid is indestructible.

Fourth: The thickness of the pipe is uniformly one-twelfth its internal diameter, which greatly increases its strength as compared with common vitrified **Sewer Pipe.**

Fifth: With the **Improved Sockets** absolute water-tight joints may be made, which cannot be done with the old style sockets.

Sixth: Being made in two and one-half foot sections (the usual length being two feet) one joint is avoided in every ten feet of conduit, thereby increasing its strength and lessening the liability to leakage.

Seventh: The increased length of the sections reduces the cost of labor and cement in laying the pipe about **twenty per cent.**

VITRIFIED PIPE is now in successful use for **Water-works** at Little Falls and New Amsterdam, N. Y.; La Salle, Ill., and many other places.

READ THE FOLLOWING LETTER:

LA SALLE, Ill., Jan. 28, 1889.

Messrs. Blackmer & Post, St Louis, Mo.:

GENTLEMEN: Returning from Bloomington, where I have been attending the meeting of the Association of Illinois Civil Engineers and Surveyors, I find your letter of 21st inst. You owe me nothing: I feel it my duty to answer your questions or send you any blue prints you may require, because you have fulfilled your contract with the city of La Salle in an honorable way, and I take pleasure in stating,

First: The 10,400 feet of 24-inch Double Strength Culvert Pipe, furnished by you to the City of La Salle for a Water-Works Conduit, proved satisfactory in quality, and well adapted for a gravitation water conduit, where the maximum water pressure is 8 feet.

Second: Where tight joints have to be made, as in this case, the four-inch socket, instead of the three-inch, is a great advantage.

Third: The working length of two and one-half feet, instead of two feet, is another advantage, as the number of joints is reduced twenty-five per cent.

Fourth: For gravitation water-works, where the pressure of the water does not exceed ten feet head, these pipes are more practical than iron ones, especially where the pipes are partly or temporarily surrounded with water. Iron pipes would sooner or later become corroded, but good vitrified pipes stand for an unlimited time, as the terra-cotta works at Babylon and other ancient cities prove.

Very truly yours, FRED ROTTMANN, *City Engineer.*

Send for Mr. Stephen E. Babcock's Treatise on the use of Vitrified Pipe for Water-Works; also, our Pamphlet, "Something About Culvert Pipe."

CORRESPONDENCE INVITED.

BLACKMER & POST, St. Louis, Mo.

Contractors.
Hickler, Jno. 133
Higgins, Jno. 138
*Hill, D. C. 396
Hillpot, J. Irving, Mt. Holly, N. J. 207
Hinds & Bond, Watertown, N. Y. 671
Hoar, J. A., Newport, R. I. 96
*Hogan, Peter, Albany, N. Y. 412
Holly Mfg. Co., Lockport, N. Y., 2, 141, 154, 158, 183, 287, 293, 372, 374, 375, 378, 384, 386, 389, 390, 402, 409, 411, 420, 442, 453, 455, 461, 464, 475, 477, 511, 527, 546.
Holmes, A. L., Grand Rapids, Mich., 400, 403, 404, 407, 408, 410, 412, 414, 416, 417, 424, 425, 429, 430, 463, 475, 587, 594, 595, 597.
Holmes, C. M., Seguin, Tex. 582
Holmes & Wicks, Colorado Springs, Col. 597
Holtzclaw Bros., Washington, D. C. 302
Hopper, Thos. 186
Horton, Calvin & Son, Somerville, Mass. 50
Hoskin & Gailes 268
House, H. K., Norwalk, O. 376
Houston & Freeman 379
Howard, Geo., Brockton, Mass. 74
Howland & Ellis, Boston, Mass. 334, 374
Howland, A. H., Boston, Mass. 337, 421
Hubbard, J. G. 213
Hubble, O. W., Mt. Vernon, O. 376
Hult, Jno., Burlington, Ia. 493
Hunkey, J. M., Danville, Ill. 439
Huntington Hopkins & Co. 627
Hunting & Co., Miles 665
Inglis & Hunter, Toronto, Ont. 675
Inman Bros., New York City, 21, 28, 29, 69, 123, 143, 152, 153, 161, 170, 179, 211, 227, 281, 385, 482, 483, 488, 578, 612, 655.
Inter-State Gas & W. Works Co., St. Louis, Mo. 556, 564
Jacoby, John, Bridgeport, Ct. 302
Jacoby & Madden 102, 107
Jaeger, Guido, Rich Hill, Mo. 510, 574
Jamison, J., Louisville, Ky. 353
Jefferson, Adam, Mankato, Minn. 498
Jenkins, David 647
Jennings & Bamberg 321
Jeter & Boardman Gas & Water Ass'n, Macon, Ga. 321, 324, 328, 329, 331, 335, 339
Jones J., Wichita, Kans 520
Jones, J. A. 559
Jones, J. T 573
Jones & Turnan 507
Jordan & S umate, Staunton, Va. 309
Kalmbach, C. L., Tarrytown, N. Y 184
Keating & Sheehan, Detroit, Mich. 409
Kelley, M. P. 581
Keogh & Shaw, Providence, R. I. 88
King, C. I., Mahanoy City, Pa 236
King & Keith, Randolph, N. Y. 140
Kraus, Henry, Lancaster, O. 372
La Chapelle, Jos., St. Jerome, Ont. 674
Laing & Co., Dallas, Tex 578
Lambert Shield & Co 247
Lambert Bros. 371
Lang, Goodhue & Co., Burlington, Vt., 21, 28, 32, 36.
Langford, Jno. T., Boston, Mass., 58, 59, 60, 67, 74, 78, 89.
Lapoint, Jno., Turner's Falls. 86
Laut, George. 390
Laville & Co., E. L. de, Montreal, Que. 673
Leach, H. B., Philadelphia, Pa. 102
Leach & Baldwin, Philadelphia, Pa 101
Lease, George. 296
Lenehan, Charles, Cambridge, Mass. 93
Leonard & Son, C. T., So. Norwalk, Conn., 112, 122
Leonard, Francis, Norwalk, Conn. 151, 192
Lesher & Son., T. M., Easton, Pa. 257
Lewis, A. C, New Britain, Conn 114
Lewis, Henry, Flushing, N. Y. 145
Lindsay, Jas., Collingwood, Ont. 666
Linehan & Co., P., Raleigh, N. C. 317
Lobdell, Geo. W., Mattapoisett, Mass. 52, 71
Lockwood, Jno., 52 Broadway, N. Y. City. 150
Lockwood, Jno. C., Jamaica, N. Y. 172
Low, J. M., Kingston, N. Y. 144, 155, 168, 180
Lowerce, F. M 346
Mackintosh, J. W., Stellarton, Prince Edward Island. 656
Mac Ritchie & Nichol, Chicago, Ill. 404
Mahony, M., Middleton, Pa. 260
Malcolm, Peters, Philadelphia, Pa. 202
Mangan, Jno., Salem, Mass 72
Manning, A. W., Burlington, Ia. 477
Marshall & Scott. 497
Martin, Jno., St. Johns, Nfd. 656
Martin, Jno. P., Xenia, O. 373, 385
Martin, T. F., Walsenburg, Col. 600
*Martin & Shay
Mason & Fiard, Frankfort, Ky. 355
Mathewell Iron Works, Lancaster, O. 372
McAdams & Co., Plymouth, Ind. 397
McArthur Bros. St. Paul, Minn 501
McBride & Hennessey, Boston, Mass. 43
*McClellan, Wm C. 50, 80, 85, 92
McConnell & Hickler, Buffalo. 300
McCormick, A. H., Parsons, Kans., 513, 515, 560, 565.
McCormick & Moran, Pittsburgh, Pa. 369
Mc ullough, Jr., Jas 225
McDonnel, A. A. 365
McDonnel, Jos. A. 365
McDonald, Jas., Willsborough Falls, N. Y. 176
McDonald, J. K., New Glasgow, P. E. I. 656
McDougal, no., Montreal, P. Q. 662
McGuire, H. D., Portland, Ore. 610
McMahon, J. & M. 223
McMahon & Keefe, Staunton, Va. 309
McMilla , Jas. A. 242
McMillan, Willet E., Paris, Ill. 398
McNamee, Jno., Brooklyn, N. Y. 307
McNamee & Co., Brooklyn, N. Y. 206
McQuillan & Co., Toronto, Ont. 670, 671
McRae & Lally, Detroit, Mich 511, 574
McReynolds, Wm. 366
Megouin, A. C. 254
Menefee & Parkins, Staunton, Va. 309
Merigold, H 3.2
Michigan Pipe Co., Bay City, Mich., 182, 231, 397, 400, 403, 407, 410, 412, 415, 424, 425, 428, 429, 430, 463, 475, 596.
Miller & Co., A., Saratoga, N. Y. 30, 104, 121, 134
Miller, C. A. 213
Miller, Conrad, Blairstown, N. J. 196
Miller, Geo. H., Hull, P. Q. 658
Miller, M. J. 627
*Miller & Burket 251
Mills & Storey, Florence, Ala 335
Minahan, D. F., Springfield, O. 245, 373
Mitchell & Co., D., Dodge City, Kan 516
Mitchell, Jas., Bucksport, Me. 5
Mitchell, Robt. 678
Mitchell & Co., R. M., Raleigh, N. C. 317
Mitchell & Harris, Boston Mass. 75
Moffett, Hodgkins & Clarke, Syracuse, N. Y., 126, 131, 135, 144, 148, 161, 188, 317, 320, 340, 368, 401, 410, 421, 446, 461, 463, 500, 666, 668.
Moore & Shaler, New York City, N. Y. 184
Morgan, Geo. C., Chicago, Ill., 415, 427, 428, 440, 445, 451, 452, 455, 459, 462, 474, 477, 492.
Morgan, P. W. 540
Morrison, Ellis, New Castle, Pa. 286
Morrison, W. W, Lock Haven, Pa. 240
Mosher, S. W., Randolph, Neb. 535
Mosser, J. G. 406
Mullins, Robt. F., N. Y. City 142
Murdock & Colvin, Asheville, N. C. 314
Murphy, Dennis, Yonkers, N. Y 194
Mutchler, S. B. & C. W., Phillipsburgh, N. J. 212
Myers & Son, H. M., Hillsdale, Mich. 424
Nat'l Bldg. Asso., St. Louis, Mo. 597
Nat'l Iron & Brass Wks., Dubuque, Ia. 342, 484, 495, 500, 530.
Nelson M'f'g Co., N. O., St. Louis, Mo. 507, 544
New England Construction Co., Newport, R. I. 181
Newman, J. J., Providence, R. I. 5, 6, 7, 11, 12, 14, 98.
Nichols, David M., N. Y. City, N. Y. 194
Nichols & Co., J. W., Florence, Ala. 335
Nichols & Co., W. T., Wellsburgh, W. Va. 313
Nixon, Jas. 281
Noble Bros & Co., Anniston, Ala. 326, 332
Nolan E. J. 267
Nolan, Bros. 268
Norcross Bros., Worcester, Mass. 205
Norman, Geo. H., Newport, R. I. 36, 51, 53, 54, 65, 66, 67, 68, 70, 72, 75, 96, 97, 123, 151.
Northwestern Water & Gas Supply Co., Minneapolis, Minn., 456, 481, 497, 500, 541, 543.
Norton, P. M., Danville, Ill. 439
Norwalk Water Pipe & Const. Co., Norwalk, N. Y. 175
O'Donnell, John Patrick. 557
Ohren & Schwartz 281
Orange Improvement Co. 603
O'Reilly, Owen. 267
Page, F. R., Malden, Mass. 25
Palmer & Son, E. E., Kansas City, Mo. 3, 513

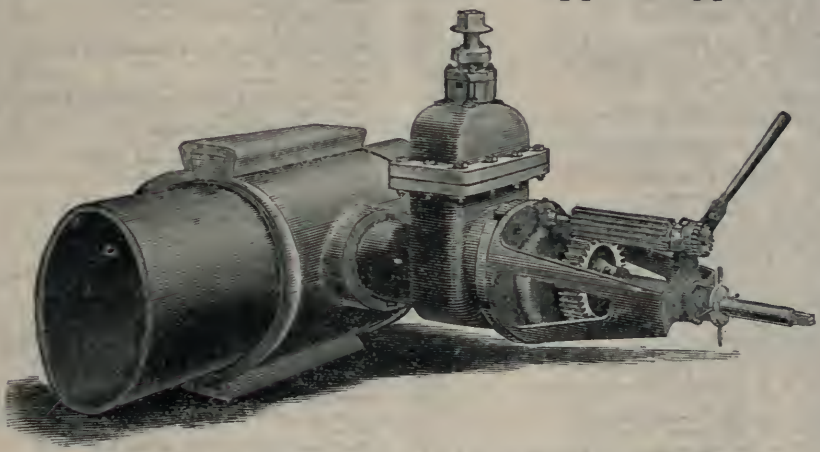
NO MORE SHUTTING GATES

To Make any size connections Required,

EITHER FOR WATER, GAS OR OIL.

A. P. SMITH'S PATENT

Connecting Branch Sleeve and Tapping Apparatus.



What Every Water Department Has Been Looking For.

A tapping apparatus to make large connections without shutting off the water or diminishing the pressure. This is now an accomplished fact, no experiment. It has passed the experimental stage, having been used by the Water Departments of several cities for the past two years and over with entire success, and with a great saving to the departments, connections having been made 2, 3, 4, 6, 8, 10 and 12 ins., with mains from sizes 4 to 36 ins. Connections can be made up to the full size of the main, as a 6-in. connection with a 6-in. main, 10-in. connection with a 10-in. main, and so on to any size required.

In making connections by this method the circular piece cut from the main is removed by the tapping apparatus, and is not allowed to fall into the main. By this method it is not necessary to use special castings in laying mains; saves trouble and expense of cutting the pipe to place special castings in their proper positions; either double or single connections can be made with the same sleeve, and at any desired place on the main; connections can be made without the gate, if desired. Fire Hydrants can be located and set up on any line of mains already in use, thus enabling cities which have large mains and no hydrants connected with them to do so without any risk.

Connections for automatic sprinklers, hydraulic elevators, water motors and for factories can now be made by this tapping apparatus as easily as ⅝-in. or 1-in. taps.

For further information address

ANTHONY P. SMITH,

128 & 130 Halsey St., Newark, N. J.

Contractors.
Parker & Co., W. S., N. Y. City..... 425
Patent Water & Gas Pipe Co., Jersey City, N.J. 93
Patrick, Wm., Phœnix, N. Y..... 173
Patterson, L. F., Bainbridge, Ga..... 323
Pearsons, G. W., Kansas City, Mo..... 512
Peet & Son, E. W..... 499
Penn Pipe M'f'g Co., Germantown, Pa.....207, 237
Perkins, P. B., Springfield, Ill... .....491, 557, 569
Pfeiffer & Co., Jno., Cincinnati, O..... 323
Phelps, Geo. W..... 406
Philbin, M., Chicago, Ill..... .....347, 369, 383
Phipps, B. J., Tazewell, Va 309
Pike & Son, H. H., Cambridgeport, Mass....47, 78
Pittston, W..... 265
Pond Engineering Co., St. Louis, Mo 488
Pond & Masten..... 560
Porch, Jas., Chebanse, Ill..... 434
Porter, Jno 251
Porter, N. C., Stoughton, Mass..... 85
Porter M'f'g Co., Syracuse, N. Y..... 381
Porter, Jackson & Co., So. Chicago, Ill..... 370
Powett, C. H., Fargo, No. Dak..... 547
Price & Stamberg, Plymouth, Ind..... 397
Price Mfg. Co..... 462
Pueblo Mach. Co., Pueblo, Colo..... 591
Ravell & Pipple..... 395
Raymond & Campbell, Middletown, Pa..... 240
Reed & Son, H. J., Canajoharie, N. Y 136
Regan, Thomas H., Philadelphia, Pa..... 255
Reid, D. S., Canajoharie, N. Y..... 128
Rich, Jas. W 592
Richardson, Wm., Red Bank, N. J..... 213
Richardson, W. D., Springfield, Ill 579
Rickert, Thos. H., Pottsville, Pa..... 236
Rigby, H. P. B 349
Ringer & Kunner, Slatington, Pa 274
Roberts, Wesley 489
Robinson, H. L., East Boston, Mass..... 69
Robinson, J. I., Bainbridge, Ga 323
Rockford Const. Co., Rockford, Ill..... 445
Rodamish, Geo. A..... 605
Ross, R. H., Clinton, Ill..... 439
Rumsey, Jas. J., Canton, O..... 375
Runele & Sons, V. S..... 625
Rush, M., Parkersburgh, W. Va..... . 313
Russell & Alexander, Chicago, Ill., 523, 589, 592, 596, 598, 601, 602.
Rutherfoord, Jno. W., N. Y. City 104, 203
Ryan, E., Springfield, O..... ... . 370, 382
Ryan & Booth..... 672
Ryan & McDonald, Waterloo, N. Y..... 159
Saunders & Church, Pendleton, Ore..... 612
Saxton, A. J., Toronto, Ont.... 680
Schealer, John G., Boyertown, Pa..... 223
Schleckman, Jacob, Lancaster, O..... 372
Scheid & Jarrett, Lock Haven, Pa..... 268
Schellner, Jacob..... 273
Schroeder, Chas., Columbus, Neb ..528, 529, 532, 536
Scovel & Irwin Construction Co., Nashville, Tenn.....333, 354
Seagler, A., Doylestown, Pa..... 255
Sckell, A. C..... 414
Seymour, H. G., Chillicothe, Mo. 555
Seymour, J. A..... 223
Shaler, Mr..... 659
Shanks, W. F., Louisville, Ky..... 353
Shanley, Edward, Catskill, N. Y.....136, 189
Shelton, Nathan, Omaha, Neb..... 442
Sherman, E., Goderich, Ont..... 667
Sherman, Wm., Troy, N. Y.....110, 156
Sherman & Flagler, Troy, N. Y..... 31
Sherman, Flagler & Babcock, Troy, N. Y..... 146
Sherman & McDonough, Troy, N. Y. 131, 135, 156, 162
Sherrill, Wm..... 675
Shields, H..... 528
Shrunn, M., Salem, Ind..... 298
Simar & Co., V. D 500
Slemons, James..... 410
Smith, A. R..... 24
Smith, Francis H., New York City..... 140
Smith, John R..... 84
Smith & Vaile Co., Dayton, O..... 377
Snow, F. A., Providence, R. I..... . ....104, 114
Snow Bros 485
Snyder, W. T..... 361
Snyder & Williams, Dayton, O..... 388
Spore, J. L., East Portland, Ore..... 610
Stanley, L. B., Collinwood, O..... 362
Stanton & Doyle, Cohoes, N. Y..... 137
Starr, Jr., Jesse W., Philadelphia, Pa.....4, 205
Stein, Albert, Mobile, Ala..... 342
Stephens, Benj. F., Flatbush, N. Y.....143, 147
Stephens, Turner & Burns, London, Ont..... 664
Stevens, A. W., Logansport, Ind..... 393
Stevens, L. B., Toledo, O..... 355
Stevens & Burns, London, Ont..... 669
Stookey, M. T., Belleville, Ill..... 450
Strang, A. L., Omaha, Neb.....527, 529
Strang Co., A. L....527, 529, 530, 531, 533, 537, 538, 550
Studley & Co., E. G., Grand Rapids, Mich.... 426
Sullivan & Conroy, Providence, R. I..... 301
Sullivan & Wilkerson, Syracuse, N. Y. 176
Sutherland, Wm., Mt. Denison, N. S.....652, 654
Sutherland & Cochran, Kentville, N. S..... 652
Sutphin, E., St. Louis, Mo., 335, 510, 514, 519, 523, 580, 582.
Swan & Co., W. E..... 466
Sykes & Co., E. T., Minneapolis, Minn., 479, 495, 539.
Talmage Bros., Mt. Gilead, O..... 376
Taylor, Ben..... 340
Taylor, E. E., Georgetown, Tex..... ... 581
Taylor, W. W., Charleston, W. Va., 207, 344, 384
Thomas Bros., Turner's Falls, Mass..... .. 86
Thomas & Gorman, Houston, Tex..... 571
Thomas, R. B., Clarion, Pa.....219, 268, 269, 281
Thomas, W. B..... 622
Thompson, Heber S., Pottsville, Pa..... 236
Tibbs, T. L..... 138
Tierney, Myles, N. Y. City..... .. 203
Tippett & Wood, Phillipsburgh, N. J...197, 212, 467
Tourville & Co..... 665
Townsend & Son, S. P., Hartford, Conn..... 125
Troy Public Works Co., Troy, N. Y.... 176, 179, 187
Turner, Tremont..... 489
Turner, Clarke & Rawson, Boston, Mass... 9, 519
Union Iron Works, Chattanooga, Tenn. 325, 326, 343
U. S. Steam & Wind Pump Co..... 521
U. S. Wind E. & P. Co., Batavia, Ill....431, 435, 450, 478, 482, 484, 489, 490, 492, 525, 541.
Van Doren, J. I., Phœnix, N. Y..... 173
Vanborne, C..... 326
Van Vranken, Benj., Schenectady, N. Y..... 178
Viau, Theophile, Hull, P. Q 658
Viola, Jno..... 79
Wagner, Jacob..... 183
Walker, M., Fenton, Mich.....373, 403, 407, 411, 415, 416, 419, 421, 423, 424, 427, 429, 533.
Walsh, Jas 675
Walters, W. A., Phœnix, N. Y..... 173
Ward, Jno. F., Jersey City, N. J...203, 232, 307, 683
Ward, Zeb., Little Rock, Ark.... 568
Ward & Leary, Jersey City, N. J..... 182
Warren, Gardner..... 44
Wakefield, E. W..... 491
Water, Light & Power Co., St. Louis, Mo..435, 450, 459, 516.
Watcrous Engine Wks., Brantford, Ont..... 679
Watts, Sylvester, St. Louis, Mo 576
Webb & Co., A., Asheville, N. C..... 314
Weeks, C. A., Broken Bow, Neb..... 528
Wellen, A. K., Morris, Ill 493
West, Jos. A..... 647
Westcott & Manly.... 1
Westcott & Sons, Jos., Portland, Me..... 7
Wetherill & Co., Robt., Chester, Pa..... 288
Wheeler, E. P., Beloit, Wis..... 492
Wheeler & Parks, Boston, Mass., 3, 18, 42, 110, 118, 119, 122, 330.
White, G. W., Pulaski, N. Y.....175, 189
White, J. C, Baker City, Ore..... 609
White, Wm., Portland, Ore. 632
White & Bro., Wm. H., New York City..... 305
Whitling, Daniel, St. Petersburgh, Pa 270
Whitsit & Adams..... 349
Wicks, S. T 595
Wiley Const. Co., Omaha, Neb..... 171, 382, 397, 490
Wiley, S. L., Omaha, Neb..... .. ..56, 423
Willard, Cyrus, Los Angeles, Cal..... 640
Williams, Robt..... 138
Wilson, E., Tecumseh, Mich..... 428
Wingate, E. B., Winsdeld, Kan..... 391
Wisconsin Const. Co., Boston, Mass....380, 466, 472
Wood R. D., & Co., Phila., Pa., 28, 34, 49, 107, 121, 136, 153, 179, 195, 206, 216, 233, 242, 247, 279, 281, 302, 362, 390.
Woolston, Geo. F., New York City.....552, 553, 602
Wright, L. J..... 110
Wright & Hughes, Newtown, Conn..... 198
Young, J. Marshall, Easton, Pa..... 275
Young Bros., Philadelphia, Pa..... 224

RATCHET DIE STOCK.

Designed for threading water pipes in confined places, *and without removing the pipe*, will do its work in *closer quarters* than any similar tool.

The testimonials below tell its whole story :

GENTLEMEN : We have had your special make Ratchet Die Stock in constant use for a number of years. During this time we have used other makes, but have found none that suits us as well as yours. As there are NO EXPOSED ADJUSTMENTS TO GET OUT OF ORDER OR BROKEN, it is *more desirable* than any stock we have ever used, and after *eight or ten years'* experience we can most heartily recommend it as *the best* for ditch work in the market.

PORTLAND WATER CO.,
PORTLAND, Me., June 5, 1889. By E. R. Payson, Secy.

* * * * * * We consider it *the most convenient and best* Die Plate for our work we have ever used.

JOHN G. BRADY,
WORCESTER, Mass., Aug. 26, 1889. Water Commissioner.

Lowell Wrench Co., Worcester, Mass.,

RATCHET WRENCHES. RATCHET DRILLS.

OIL WELL SUPPLY CO., LIMITED,

82 FULTON STREET, NEW YORK.

ALSO AT PITTSBURGH, BRADFORD AND OIL CITY, PENNSYLVANIA.

Manufacture and Sell Every Article, Tool or Appliance Needed at

ARTESIAN WELLS,

Either for Gas, Oil, Water, or Mineral Tests.

BOILERS, CASING,
ENGINES, FITTINGS,
DERRICKS, PUMPS,
TUBING, CORDAGE.

Brass & Iron Goods & Supplies

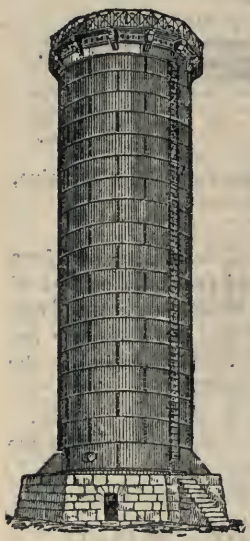
For Steam, Gas, Petroleum, or Water.

CATALOGUES
and
PRICE LISTS
on
APPLICATION.

PORTER MFG. CO.,

LIMITED.

Manufacturers and Builders of



Tanks,
Stand-Pipes,
Boilers,
Engines
and Stone
Crushers.

Specifications Solicited.

ESTIMATES CHEERFULLY GIVEN.

SYRACUSE, N. Y.

BASSETT BROS.,

Engineers and Contractors.

Water-works systems designed, built or operated.

298 MAIN STREET BUFFALO, N. Y.

FRANK L. FULLER,

M. AM. SOC. C. E.,

Civil and Hydraulic Engineer,

ROOM 35-36, 12 PEARL STREET,
BOSTON, MASS.

Special attention given to Water Supply and Drainage.

JACOB A. HARMAN, C. E.,

Mem. Ill. Soc. Eng. and Surv.,

WATSEKA, ILL.

Plans, Specifications and Estimates for Drainage, Sewerage, Water-Works and Bridges. Construction Superintended.

JOHN W. HILL,

M. Am. Soc. C. E.,

Consulting and Constructing Engineer

For Water-Works, Sewerage, etc.

21 & 22 Glenn Building, CINCINNATI O.

Globe Special Castings

FOR WATER-WORKS.

PATENTED.

Preferable as regards strength, first cost and convenience in handling.

Sold by the piece.

Carried in stock.

Send for catalogue.

Any form of special made without charge for pattern, and without delay.

BUILDERS' IRON FOUNDRY,
PROVIDENCE, R. I.

M. J. DRUMMOND, No. 192 BROADWAY,
NEW YORK SALES AGENT.

McCLINTOCK & WOODFALL,

CIVIL ENGINEERS,

Sewerage, Water-Works, Macadamized Roads, Plans, Specifications, Supervision.

W. E. McCLINTOCK, CONSULTING ENGINEER,

23 Court St., Room 308, Boston.

ANDREW ROSEWATER, M. Am. Soc. C. E. — FRANK CHRYSLER.

ROSEWATER & CHRYSLER,

Civil and Sanitary Engineers.

SPECIALTIES: Sewerage, Grades, Municipal Public Works.

422 Bee Building, Omaha, Neb.

KNOXVILLE, TENN.,
Room 10, City Hall, P. O. Box No. 21.

WRIGHT AND WOOD,

Civil and Sanitary Engineers.

Sewerage, Drainage, Water Supply, Municipal Work, Surveys, Estimates, Specifications, Superintendence.

J. C. WRIGHT, C. E. — C. F. WOOD, Jr., Am. Soc. C. E.; Engr. and Supt. Knoxville Water Co.

GEO. W. WYNN,

Civil and Hydraulic Engineer,

CEDAR RAPIDS, IOWA.

Water-Works, Sewerage, Drainage and City Improvements.

Plans, Specifications and Estimates Prepared and Construction Superintended.

Trade Mark

36 Cambridge Street.

GOULD'S STEAM AND WATER PACKING.

Patented June 1, 1880.—The Original Ring Packing.

For Piston Rods, Valve Stem of Steam Engines, Steam Pumps, and especially adapted for Water-Works and Electric Light Plants.

SELF-LUBRICATING STEAM AND WATER-TIGHT.

Less friction than any other known Packing. Never grows hard if directions are followed. Does not corrode the rod **Every Package Fully Warranted.**

N. B.—This Packing will be sent to any address, and if not satisfactory, after a trial of 30 days, can be returned at our expense. None genuine without this trade mark and date of patent stamped on wrapper. *All similar Packings are Imitations and calculated to deceive.*

THE GOULD PACKING CO., East Cambridge, Mass.
ALBION CHIPMAN, Treasurer.

Jenks' Patent Improved

DRINKING FOUNTAINS

FOR MAN AND BEAST.

Are the Best and Most Durable.

With Lamp-post for Gas or Electric Light.

Street and Sidewalk Fountains, Park or Lawn Hydrants, Settees, Drinking Cups and Chains.

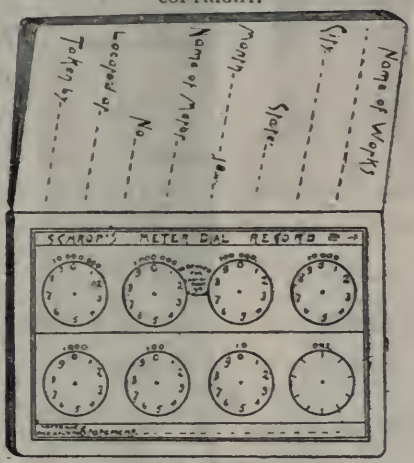
Horses may drink without unchecking. Dog trough at the base.

MANUFACTURED BY
HENRY F. JENKS, Pawtucket, R. I.

SCHROP'S

Meter Dial Records.

COPYRIGHT.

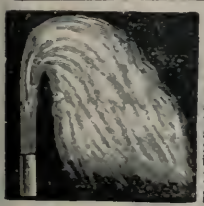


PATENTED.

The surest way known for reading water, gas or other meters. Does not require an **expert.** It is a simple, easy and cheap method. By this method the face of a meter can always be kept on file at the **office** of the works. Write for prices.

IRA S. SCHROP,

SOUTH BEND, IND.



ARTESIAN

Wells, Oil and Gas Wells, drilled by contract to any depth, from 50 to 4000 feet. We also manufacture and furnish everything required to drill and complete same. Portable Drilling Machines for wells from 100 to 1000 ft. Send 25c. for illustrated catalogue.

Pierce Artesian & Oil Well Supply Co., 80 Beaver St., New York

GEM WATER MOTOR.

For supplying houses with pure water by pressure from water-works. Manufactured by

GEO. J. ROBERTS & CO.,

Dayton, Ohio.

STETTIN "Anchor Brand" PORTLAND CEMENT

—HAS NO SUPERIOR.—

Send for Tests and Pamphlet to

ERSKINE W. FISHER,

Welles Building, 18 Broadway, New York.

A TREATISE ON

Hydraulic and Water Supply Engineering,

By J. T. FANNING, Consulting Engineer.

The most complete theoretical and practical treatise yet published on these subjects: written by an engineer of large experience in designing and the construction of public works. 8vo, 675 pages, 200 illustrations, many new formulas. Price $5. For sale by ENGINEERING NEWS PUBLISHING COMPANY.

TIPPETT & WOOD

BUILDERS OF

IRON BRIDGES·
TURNTABLES·
STAND-PIPES·
WATER TOWERS·
STEAM-
BOILERS·
DIGESTORS·
TANKS·
STACKS· ETC·

GENERAL CON-
TRACTORS IN
IRON-
WORK·

Phillipsburg,
New Jersey.

GALVIN BRASS & IRON WORKS

DETROIT. MICH.

MANUFACTURERS OF

Galvin's Compound Wedge Gate Valves,

For Steam, Water and Gas;

GALVIN'S CONICAL CASE GATE FIRE HYDRANT,

GALVIN'S IMPROVED MATHEW FIRE HYDRANTS.

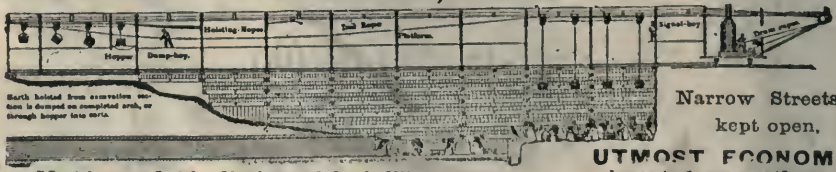
ALSO

General Brass and Iron Goods,

For Steam, Water and Gas.

ITS EFFICIENCY THOROUGHLY DEMONSTRATED IN PRACTICE.
BEST ON EARTH.
THOMSON WATER METER
FIRST PRIZE PARIS 1889.
ACCURATE COMPACT
CHEAPEST LIGHTEST
POSITIVE DISPLACEMENT
PERFORMANCE GUARANTEED.
CIRCULARS ON APPLICATION TO
THE WATER WASTE PREVENTION CO.,
12 TEMPLE COURT,
NASSAU & BEEKMAN STREETS,
NEW YORK.
U.S.A.
OFFICIALLY ADOPTED BY, AND OVER 3,000 IN USE IN, THE CITY OF NEW YORK.

CARSON TRENCH MACHINE CO., 21 Hamilton st., Boston, Mass.



Narrow Streets kept open.

UTMOST ECONOMY in cost of excavation.

Machines to let for digging and back-filling Sewer and large Water Trenches. Some simple, some complex. Many sizes. Ten years' use. Used this season in Boston, Montreal, Worcester, Albany, Brooklyn, Buffalo, Cleveland, Columbus, Detroit, Cincinnati, Chicago, St. Louis and many other places.

AN IMPROVED SYSTEM OF CONDENSATION
FOR PUMPING ENGINES.

PATENTED SEPT. 6, 1881.

Adopted by the HOLLY MANUFACTURING CO., Lockport, N. Y.; the GORDON STEAM PUMP CO, Hamilton, Ohio.

This system of condensation avoids all loss of water through the condenser, while the circulation is under complete control.
Over 10,000 square feet of cooling surface on this system now in daily use.

ADDRESS

JOHN W. HILL, 21 and 22 Glenn Building,
CINCINNATI, OHIO.

The Taunton Loco. Mfg. Co.,

TAUNTON, MASS.

WM. R. BILLINGS, TREASURER.

BOILER DEPT.

Steam Boilers. Tanks. Lead Furnaces.

FOUNDRY DEPT.

Special Castings. Street Stand Pipes. Stop Boxes.

BLACKSMITH DEPT.

Caulking Tools. Forging of any Description.

MACHINE SHOP.

Tools and Work of every Variety.

Cumberland M'f'g Co.

Warren Filter

220 Devonshire St. Boston.

HYATT SYSTEM OF WATER PURIFICATION

BY THE USE OF

Mechanical Filtration Combined with Aeration and Coagulation.

This, the pioneer company, is the owner of over seventy patents, which include SECTIONAL WASHING, SURFACE AGITATION, CHECK VALVES and METHOD OF USING COAGULANTS, which inventions are now being infringed by rival makers. PURCHASERS ARE WARNED AGAINST INFRINGEMENTS. Compare the continuous and uninterrupted operation of our system in water-works for years with the imperfect, irregular and inefficient action of other systems.

OUR NEW METHOD OF CONSTRUCTING HORIZONTAL FILTERS COMBINES GREAT STRENGTH and COMPACTNESS.

HYATT PURE WATER CO.,

18 Cortlandt Street, New York City.

THE SMITH & VAILE CO.,

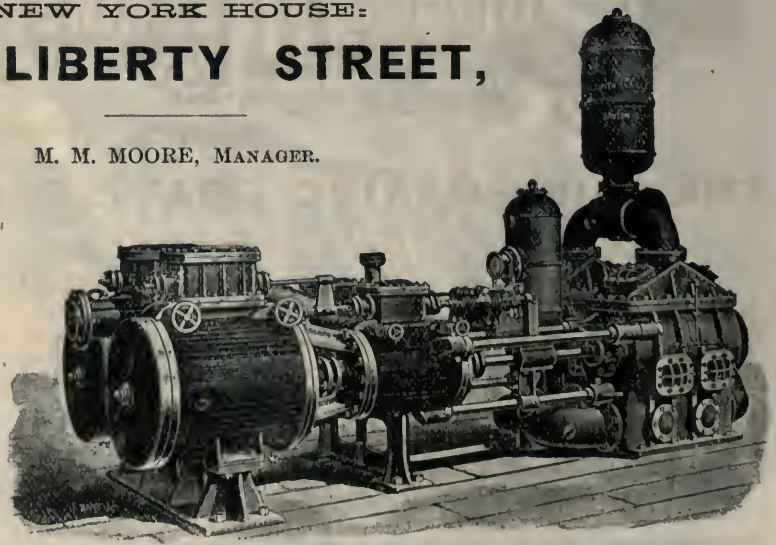
BUILDERS OF

Duplex Pumping Engines.

NEW YORK HOUSE:

112 LIBERTY STREET,

M. M. MOORE, MANAGER.



COMPOUND DUPLEX PUMP, 18 and 30 x 16 x 24.

Barr Pumping Engine Company,

Germantown Junction, Philadelphia, Pa.,

MAKERS OF

HIGH CLASS PUMPING MACHINERY

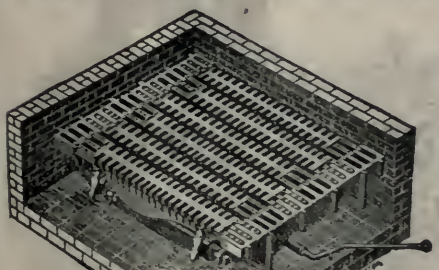
For Water-Works and Other Services.

All Work Made to Gauge and Thoroughly Interchangeable.

ILLUSTRATED CATALOGUE ON APPLICATION.

Pond Engineering Co.
Contracting Engineers,
FOR EVERY VARIETY OF
Pumping Machinery.
707 & 709 MARKET ST.
ST. LOUIS.
SEND FOR CIRCULAR.

THE HUB SHAKING GRATE, Patented.



The Foundation of Economy of Fuel and Labor in Steam Production.

The best, cheapest and most practical system of obtaining perfect combustion in boiler furnaces. The test of time has fully proved its durability and unfailing usefulness. From 15 to 30 per cent. saved. More largely used in WATER-WORKS STATIONS THAN ANY OTHER. Will cost you nothing to test it. Don't make any mistake, but try THE HUB SHAKING GRATE.

Descriptive Pamphlet, with Hundreds of first-class References FREE.

Manufactured by PORTSMOUTH WRENCH CO., 151 Congress St., Boston.

The Gaskill-Holly Pumping Engine.

ITS RECORD UNPARALLELED.

Comparison Challenged with any other in the World. 96 of these Justly Celebrated Engines contracted for in the Last two Years, Average Daily Capacity of which is 3,915,625.

Consider the Points which Demonstrate its Superiority.

1. The first Gaskill crank and fly-wheel pumping engine was built and put into service at Saratoga Springs, N. Y., in 1882, eight years ago.
2. Since that time 118 of these engines have been constructed or contracted for, an average of about 15 per year.
3. DURING LAST YEAR—1889—40 HAVE BEEN BUILT OR CONTRACTED FOR, AVERAGING ONE EVERY NINE DAYS. Average daily capacity. 3,915,000 gallons.
4. The duty of the first engine of this type at Saratoga on contract test, was 112,899,983 foot-pounds per 100 pounds of coal consumed.
5. The average duty of above engine in current service from 1884 to 1889, inclusive—six years—was 105,910,739 foot-pounds from coal actually consumed.
6. During the above interval of six years the cost of repairs was less than $100, as certified by officials in charge.
7. Another engine of the same type, of 8,000,000 gallons daily capacity, was constructed for Saratoga Springs, and tested and accepted in October, 1889. The duty obtained, as reported by Prof. Greene, of Troy, N. Y., was 113,378,479 foot-pounds from coal consumed, and 117,936,698 on an evaporation of ten to one.
8. Other engines of the same type, in number about 40, have been tested by some of the most eminent engineers in the United States, all of them developing high duty, beyond all former precedent; and at Dayton, O., eclipsing 10,000,000 Engines in a duty of 124,782,157 foot-pounds on a ratio of ten to one evaporation.
9. The capacity of these engines manufactured thus far ranges from 1,000,000 to 20,000,000 gallons daily.
10. They are in use in Boston, Philadelphia, Chicago, Buffalo, Washington, Kansas City, Omaha and other large cities in the United States,
11. The aggregate capacity of these engines, constructed or contracted for to date, is 555,000,000 gallons daily, which, with other types, make a grand total of 356 engines and 1,077,150,000 gallons, with an average of 3,025,700 each.
12. In symmetry of proportion, weight, strength, economy, durability, price, comparison is challenged with any other engine manufactured in this or any other country.
13. An illustrated pamphlet of about 300 pages is going through the press, giving full history of the above phenomenal pumping engine, with full reports of duty tests in detail as made by about 30 mechanical experts, eminent in their profession, which will soon be ready for delivery, and which will be mailed upon application to all who are interested in, or may have occasion to purchase pumping engines. The book demonstrates beyond all dispute that the Gaskill compound crank and fly-wheel pumping engines, manufactured under patents by the Holly Mfg. Co., far surpass any other engine manufactured in the World.

The Gaskill Pumping Engine is made either of the horizontal or vertical type, as required, beside which the Holly Mfg. Co. make, of any capacity:
Vertical Rotative Beam Pumping Engines, Vertical Triple Expansion Pumping Engines, Duplex Direct-Acting Pumping Engines, Water Power Pumping Machinery, Straight Way Gate Valves and Check Valves, 4-in. to 36-in., Fire Hydrants all sizes.

Address for Pamphlet or Other Information,

The Holly Manufacturing Company,

Lockport, N. Y.

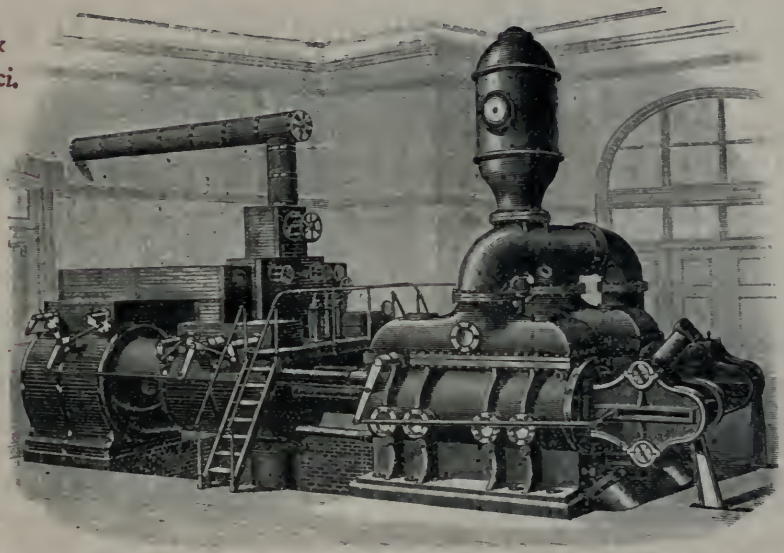
BRANCH OFFICES:

45 Broadway, New York City; 657 Washington St., Boston, Mass.;
La Salle and Adams Sts., Chicago, Ill.; 94 Common St., New Orleans, La.

Techno
H

THE WORTHINGTON HIGH DUTY PUMPING ENGINE

Physical &
Applied Sci.
Serials



HORIZONTAL, VERTICAL OR BEAM

REGULAR COMPOUND OR TRIPLE EXPANSION

LOWEST FIRST COST AND MAINTENANCE. HIGHEST ECONOMY

Total Daily Capacity of Worthington Pumping Engines now in Service

OVER 2,000,000,000 GALLONS

An Illustrated Catalogue Descriptive of the Worthington Pump ng Engines will be furnished on application to

HENRY R. WORTHINGTON

86 and 88 LIBERTY STREET

145 BROADWAY

NEW YORK CITY

C. H. VENNER & COMPANY,

BANKERS,

33 Wall St., New York;
8 Congress St., Boston,

DEALERS IN

HIGH GRADE INVESTMENT SECURITIES

Members of New York and Boston Stock Exchanges.

UNITED WATER WORKS CO.,

(LIMITED.)

CAPITAL, $1,000,000.

ORGANIZED 1885.

33 WALL STREET, NEW YORK.

NEGOTIATES

LARGE ISSUES OF

Water Works Securities.

JOHN W. FAIRBANKS, President.
CLARENCE H. VENNER, Vice-President.
FREDERICK H. MILLS, Treasurer.